Dialog Search 11/6/2008 10803549

Connecting via Winsock to Dialog

Logging in to Dialog

Trying 31060000009998...Open

DIALOG INFORMATION SERVICES
PLEASE LOGON:
****
ENTER PASSWORD:
****
Welcome to DIALOG

Dialog level 05.22.00D

Last logoff: 02nov08 15:00:01
Logon file405 06nov08 17:27:48
*** ANNOUNCEMENTS ***
***
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how to use the link and a list of files that contain the link.

NEW FILE
***File 651, TRADEMARKSCAN(R) - China. See HELP NEWS 651 for details.
RESUMED UPDATING
***File 523, D&B European Financial Records
***
RELOADS COMPLETED
***File 227, TRADEMARKSCAN(R) - Community Trademarks

***

FILES RENAMED

***File 321, PLASPEC now known as Plastic Properties Database

***

FILES REMOVED

***File 601,Early Edition Canada

***

>>>For the latest news about Dialog products, services, content<<<
>>>and events, please visit What's New from Dialog at <<<
>>>http://www.dialog.com/whatsnew/. You can find news about <<<
>>>a specific database by entering HELP NEWS <file number>. <<<

YTEXT is set ON as an alias for 15,16,148,160,275,621
KTEXT is set ON as an alias for 9,20,476,610,613,624,634,636,810,813
MTEXT is set ON as an alias for 2,35,65,77,99,233,256,278,474,475,583
STEXT is set ON as an alias for 623,473,47,635,570,PAPERSMJ,PAPERSEU
HTEXT is set ON as an alias for 625,268,626,267,139
FTEXT1 is set ON as an alias for 15,9,275,621,636,16,160,148
FTEXT2 is set ON as an alias for 610,810,476,624,634,20,47
BIB1 is set ON as an alias for 35,139,583,65,2,144,233,474,475,99
SUB26 is set ON as an alias for PAPERSEU, PAPERSMJ,570,635
SUB35 is set ON as an alias for 625,268,626,267,608

* * *

SYSTEM:HOME
Cost is in DialUnits
Menu System II: D2 version 1.8.0 term=ASCII

*** DIALOG HOMEBASE(SM) Main Menu ***

Information:

1. Announcements (new files, reloads, etc.)
2. Database, Rates, & Command Descriptions
3. Help in Choosing Databases for Your Topic
4. Customer Services (telephone assistance, training, seminars, etc.)
5. Product Descriptions

Connections:

6. DIALOG(R) Document Delivery
7. Data Star(R)

/H = Help /L = Logoff /NOMENU = Command Mode

Enter an option number to view information or to connect to an online service. Enter a BEGIN command plus a file number to search a database (e.g., B1 for ERIC).

```
? b 410

      06nov08 17:27:49 User264721 Session D53.1
          $0.00    0.269 DialUnits FileHomeBase
    $0.00  Estimated cost FileHomeBase
    $0.00  Estimated cost this search
    $0.00  Estimated total session cost   0.269 DialUnits

File 410:Dialog Comm.-of-Interest Newsletters 2008 /Mar
      (c) 2008 Dialog

     Set  Items  Description
     ---  -----  -----------
? set hi %%%;set hi %%%
HILIGHT set on as ''
HILIGHT set on as ''
? b YTEXT, KTEXT, MTEXT,  STEXT, HTEXT, ftext1, ftext2, bib1, sub26, sub35
>>>        476 does not exist
>>>         77 does not exist
>>>        233 does not exist
>>>        473 does not exist
>>>4 of the specified files are not available
      06nov08 17:28:08 User264721 Session D53.2
          $0.00    0.115 DialUnits File410
    $0.00  Estimated cost File410
    $0.08  TELNET
    $0.08  Estimated cost this search
    $0.08  Estimated total session cost   0.384 DialUnits

SYSTEM:OS  - DIALOG OneSearch
  File  15:ABI/Inform(R) 1971-2008/Nov 06
        (c) 2008 ProQuest Info&Learning
  File  16:Gale Group PROMT(R) 1990-2008/Oct 29
        (c) 2008 Gale/Cengage
*File  16: Because of updating irregularities, the banner and the
update (UD=) may vary.
  File 148:Gale Group Trade & Industry DB 1976-2008/Nov 04
        (c) 2008 Gale/Cengage
*File 148: The CURRENT feature is not working in File 148.
See HELP NEWS148.
  File 160:Gale Group PROMT(R) 1972-1989
        (c) 1999 The Gale Group
  File 275:Gale Group Computer DB(TM) 1983-2008/Oct 27
        (c) 2008 Gale/Cengage
  File 621:Gale Group New Prod.Annou.(R) 1985-2008/Oct 14
        (c) 2008 Gale/Cengage
```

File 9:Business & Industry(R) Jul/1994-2008/Nov 05
(c) 2008 Gale/Cengage
*File 9: UD names were adjusted to reflect load date.
All data is present.
File 20:Dialog Global Reporter 1997-2008/Nov 05
(c) 2008 Dialog
File 610:Business Wire 1999-2008/Nov 06
(c) 2008 Business Wire.
*File 610: File 610 now contains data from 3/99 forward.
Archive data (1986-2/99) is available in File 810.
File 613:PR Newswire 1999-2008/Nov 06
(c) 2008 PR Newswire Association Inc
*File 613: File 613 now contains data from 5/99 forward.
Archive data (1987-4/99) is available in File 813.
File 624:McGraw-Hill Publications 1985-2008/Nov 06
(c) 2008 McGraw-Hill Co. Inc
File 634:San Jose Mercury Jun 1985-2008/Nov 04
(c) 2008 San Jose Mercury News
File 636:Gale Group Newsletter DB(TM) 1987-2008/Oct 29
(c) 2008 Gale/Cengage
File 810:Business Wire 1986-1999/Feb 28
(c) 1999 Business Wire
File 813:PR Newswire 1987-1999/Apr 30
(c) 1999 PR Newswire Association Inc
File 2:INSPEC 1898-2008/Oct W1
(c) 2008 Institution of Electrical Engineers
File 35:Dissertation Abs Online 1861-2008/Oct
(c) 2008 ProQuest Info&Learning
File 65:Inside Conferences 1993-2008/Nov 06
(c) 2008 BLDSC all rts. reserv.
File 99:Wilson Appl. Sci & Tech Abs 1983-2008/Aug
(c) 2008 The HW Wilson Co.
File 256:TecInfoSource 82-2008/Jan
(c) 2008 Info.Sources Inc
File 278:Ei Compendex(R) 1970-2008/Oct W3
(c) 2008 Elsevier Eng. Info. Inc.
*File 278: The file has been reloaded. See HELP NEWS 8 for details.
File 474:New York Times Abs 1969-2008/Nov 05
(c) 2008 The New York Times
File 475:Wall Street Journal Abs 1973-2008/Nov 05
(c) 2008 The New York Times
File 583:Gale Group Globalbase(TM) 1986-2002/Dec 13
(c) 2002 Gale/Cengage
*File 583: This file is no longer updating as of 12-13-2002.
File 623:Business Week 1985-2008/Nov 05

(c) 2008 The McGraw-Hill Companies Inc
File 47:Gale Group Magazine DB(TM) 1959-2008/Oct 21
(c) 2008 Gale/Cengage
File 635:Business Dateline(R) 1985-2008/Nov 06
(c) 2008 ProQuest Info&Learning
File 570:Gale Group MARS(R) 1984-2008/Oct 28
(c) 2008 Gale/Cengage
File 387:The Denver Post 1994-2008/Nov 04
(c) 2008 Denver Post
File 471:New York Times Fulltext 1980-2008/Nov 05
(c) 2008 The New York Times
File 492:Arizona Repub/Phoenix Gaz 19862002/Jan 06
(c) 2002 Phoenix Newspapers
*File 492: File 492 is closed (no longer updating). Use Newsroom, Files 989 and 990, for current records.
File 494:St LouisPost-Dispatch 1988-2008/Nov 05
(c) 2008 St Louis Post-Dispatch
File 631:Boston Globe 1980-2008/Nov 06
(c) 2008 Boston Globe
File 633:Phil.Inquirer 1983-2008/Nov 06
(c) 2008 Philadelphia Newspapers Inc
File 638:Newsday/New York Newsday 1987-2008/Nov 05
(c) 2008 Newsday Inc.
File 640:San Francisco Chronicle 1988-2008/Nov 06
(c) 2008 Chronicle Publ. Co.
File 641:Rocky Mountain News Jun 1989-2008/Nov 06
(c) 2008 Scripps Howard News
File 702:Miami Herald 1983-2008/Nov 06
(c) 2008 The Miami Herald Publishing Co.
File 703:USA Today 1989-2008/Nov 04
(c) 2008 USA Today
File 704:(Portland)The Oregonian 1989-2008/Nov 04
(c) 2008 The Oregonian
File 713:Atlanta J/Const. 1989-2008/Nov 05
(c) 2008 Atlanta Newspapers
File 714:(Baltimore) The Sun 1990-2008/Nov 05
(c) 2008 Baltimore Sun
File 715:Christian Sci.Mon. 1989-2008/Nov 06
(c) 2008 Christian Science Monitor
File 725:(Cleveland)Plain Dealer Aug 1991-2008/Nov 04
(c) 2008 The Plain Dealer
File 735:St. Petersburg Times 1989- 2008/Nov 05
(c) 2008 St. Petersburg Times
File 477:Irish Times 1999-2008/Nov 06
(c) 2008 Irish Times
File 710:Times/Sun.Times(London) Jun 1988-2008/Nov 05

(c) 2008 Times Newspapers
File 711:Independent(London) Sep 1988-2006/Dec 12
(c) 2006 Newspaper Publ. PLC
*File 711: This file does not update. See File 757 for full
daily coverage from many European sources.
File 756:Daily/Sunday Telegraph 2000-2008/Nov 05
(c) 2008 Telegraph Group
File 757:Mirror Publications/Independent Newspapers 2000-2008/Nov 06
(c) 2008
File 625:American Banker Publications 1981-2008/Jun 26
(c) 2008 American Banker
*File 625: This file no longer updates.
Use Newsroom Files 989 and 990 for current records.
File 268:Banking Info Source 1981-2008/Oct W3
(c) 2008 ProQuest Info&Learning
File 626:Bond Buyer Full Text 1981-2008/Jul 07
(c) 2008 Bond Buyer
*File 626: This file no longer updates.
Use Newsroom Files 989 and 990 for current records.
File 267:Finance & Banking Newsletters 2008/Sep 29
(c) 2008 Dialog
File 139:EconLit 1969-2008/Sep
(c) 2008 American Economic Association
File 144:Pascal 1973-2008/Nov W1
(c) 2008 INIST/CNRS
File 608:MCT Information Svc. 1992-2008/Nov 06
(c) 2008 MCT Information Svc.
*File 608: UD names have been adjusted forward.
All data is present.

```
Set  Items  Description
---  -----  -----------
```

? S (combinatorial (20n) (auction or exchange)) (s)(allocate??? or reserve????? or hold??? or held) (s) round
Processing
Processing
Processed 10 of 57 files ...
Processing
Processed 30 of 57 files ...
Processing
Completed processing all files

```
   111503  COMBINATORIAL
  1272236  AUCTION
 14680477  EXCHANGE
  1169985  ALLOCATE???
  9557783  RESERVE?????
```

```
      18629590  HOLD???
      16132313  HELD
       6000207  ROUND
    S1        7  (COMBINATORIAL (20N) (AUCTION OR EXCHANGE))
                 (S)(ALLOCATE??? OR RESERVE????? OR HOLD??? OR HELD) (S)
                 ROUND
? RD S1

>>>Duplicate detection is not supported for File 625.

>>>Duplicate detection is not supported for File 626.

>>>Records from unsupported files will be retained in the RD set.
    S2        5  RD S1  (unique items)
? S (Second near5 (round or auction or chance or bid)) (s) (modified or modification or
modifying or amend??? or constrain???)
Processing
Processed  20 of  57 files ...
Completed processing all files
             0  SECOND NEAR5 (ROUND
       1272236  AUCTION
       6655564  CHANCE
             0  BID)
       1569238  MODIFIED
        841394  MODIFICATION
        235132  MODIFYING
       1989475  AMEND???
       1726110  CONSTRAIN???
    S3   45665  (SECOND NEAR5 (ROUND OR AUCTION OR CHANCE OR BID))
(S)
                 (MODIFIED OR MODIFICATION OR MODIFYING OR AMEND??? OR
                 CONSTRAIN???)
? RD S3

>>>Duplicate detection is not supported for File 625.

>>>Duplicate detection is not supported for File 626.

>>>Records from unsupported files will be retained in the RD set.
Processing - Examined 1400 records
Processing - Examined 2600 records
Processing - Examined 3800 records
Processing - Examined 5000 records
Processing - Examined 6200 records
Processing - Examined 7400 records
Processing - Examined 8400 records
```

Processing - Examined 9600 records
Processing - Examined 10800 records
Processing - Examined 12200 records
Processing - Examined 13400 records
Processing - Examined 14800 records
Processing - Examined 16200 records
Processing - Examined 17400 records
Processing - Examined 18600 records
Processing - Examined 19800 records
Processing - Examined 21000 records
Processing - Examined 22200 records
Processing - Examined 23200 records
Processing - Examined 24200 records
Processing - Examined 25200 records
Processing - Examined 26400 records
>>>Record 624:1562235 incomplete bibliographic data - record retained in RD set
>>>Record 624:1558387 incomplete bibliographic data - record retained in RD set
Processing - Examined 27600 records
Processing - Examined 28800 records
>>>Record 813:824770 incomplete bibliographic data - record retained in RD set
>>>Record 813:425087 incomplete bibliographic data - record retained in RD set
Processing - Examined 30000 records
Processing - Examined 31200 records
>>>Record 256:2404628 incomplete bibliographic data - record retained in RD set
Processing - Examined 32600 records
Processing - Examined 33600 records
Processing - Examined 34600 records
>>>Record 631:14788034 incomplete bibliographic data - record retained in RD set
>>>Record 631:14745074 incomplete bibliographic data - record retained in RD set
>>>Record 631:1566590 incomplete bibliographic data - record retained in RD set
>>>Record 631:1565242 incomplete bibliographic data - record retained in RD set
>>>Record 631:1535611 incomplete bibliographic data - record retained in RD set
>>>Record 631:1507217 incomplete bibliographic data - record retained in RD set
>>>Record 631:616675 incomplete bibliographic data - record retained in RD set
>>>Record 631:615009 incomplete bibliographic data - record retained in RD set
>>>Record 631:613780 incomplete bibliographic data - record retained in RD set
>>>Record 631:591269 incomplete bibliographic data - record retained in RD set
>>>Record 631:574771 incomplete bibliographic data - record retained in RD set
>>>Record 631:541271 incomplete bibliographic data - record retained in RD set
>>>Record 631:514190 incomplete bibliographic data - record retained in RD set
>>>Record 631:513902 incomplete bibliographic data - record retained in RD set
>>>Record 631:503141 incomplete bibliographic data - record retained in RD set
Processing - Examined 35600 records
>>>Record 641:6573161 incomplete bibliographic data - record retained in RD set
>>>Record 702:8559143 incomplete bibliographic data - record retained in RD set
>>>Record 702:5520550 incomplete bibliographic data - record retained in RD set

```
>>>Record 702:5083984 incomplete bibliographic data - record retained in RD set
>>>Record 702:4648299 incomplete bibliographic data - record retained in RD set
>>>Record 713:5009608 incomplete bibliographic data - record retained in RD set
>>>Record 714:10781054 incomplete bibliographic data - record retained in RD set
>>>Record 714:10099153 incomplete bibliographic data - record retained in RD set
>>>Record 714:9581110 incomplete bibliographic data - record retained in RD set
Processing - Examined 36400 records
>>>Record 725:14653017 incomplete bibliographic data - record retained in RD set
>>>Record 725:14622055 incomplete bibliographic data - record retained in RD set
>>>Record 725:14217081 incomplete bibliographic data - record retained in RD set
>>>Record 725:14169060 incomplete bibliographic data - record retained in RD set
>>>Record 725:14034002 incomplete bibliographic data - record retained in RD set
>>>Record 725:14028041 incomplete bibliographic data - record retained in RD set
>>>Record 725:14026059 incomplete bibliographic data - record retained in RD set
>>>Record 725:13719059 incomplete bibliographic data - record retained in RD set
>>>Record 725:13689011 incomplete bibliographic data - record retained in RD set
>>>Record 725:13617077 incomplete bibliographic data - record retained in RD set
>>>Record 725:13613036 incomplete bibliographic data - record retained in RD set
>>>Record 725:13603084 incomplete bibliographic data - record retained in RD set
>>>Record 725:13590008 incomplete bibliographic data - record retained in RD set
>>>Record 725:13228011 incomplete bibliographic data - record retained in RD set
>>>Record 725:13032027 incomplete bibliographic data - record retained in RD set
>>>Record 725:12797054 incomplete bibliographic data - record retained in RD set
>>>Record 725:12673011 incomplete bibliographic data - record retained in RD set
>>>Record 725:12651063 incomplete bibliographic data - record retained in RD set
>>>Record 725:11863053 incomplete bibliographic data - record retained in RD set
>>>Record 725:11851027 incomplete bibliographic data - record retained in RD set
>>>Record 725:11793423 incomplete bibliographic data - record retained in RD set
>>>Record 725:11567018 incomplete bibliographic data - record retained in RD set
>>>Record 725:11339016 incomplete bibliographic data - record retained in RD set
Processing - Examined 37400 records
Processing - Examined 38600 records
Processing - Examined 40000 records
>>>Record 139:760593 incomplete bibliographic data - record retained in RD set
>>>Record 139:672984 incomplete bibliographic data - record retained in RD set
>>>Record 139:613216 incomplete bibliographic data - record retained in RD set
>>>Record 139:442938 incomplete bibliographic data - record retained in RD set
>>>Record 139:373073 incomplete bibliographic data - record retained in RD set
Processing - Examined 41400 records
Processing - Examined 42000 records
Processing - Examined 42600 records
Processing - Examined 43200 records
Processing - Examined 43800 records
Processing - Examined 44400 records
Processing - Examined 45000 records
Processed  40 of  57 files ...
```

Processing
S4 33358 RD S3 (unique items)
? S S2 AND S4
5 S2
33358 S4
S5 1 S2 AND S4
? T S5/7,K/1

5/7,K/1 (Item 1 from file: 15)
DIALOG(R)File 15:ABI/Inform(R)

03326292 1407095951
ITERATIVE MULTI-ATTRIBUTE MULTI-UNIT REVERSE AUCTIONS
Zhang, Zhuoxiu; Jin, Mingzhou
Engineering Economist v52n4 PP: 333-354 2007 CODEN: ENECAR ISSN: 0013-791X JRNL CODE: EEC
DOC TYPE: Periodical; Feature LANGUAGE: English RECORD TYPE: Fulltext
LENGTH: 22 Pages WORD COUNT: 6618

ABSTRACT: This article studies iterative multi-attribute auctions for multi-unit procurement. Order splitting among suppliers is allowed in auctions to improve efficiency and take advantage of suppliers' cost structures. Suppliers are also allowed to provide discriminative prices over units based on their cost structures. A mechanism called iterative multi-attribute multi-unit reverse auction (IMMRA) is proposed based on the assumption of the modified myopic best-response strategies. Results from numerical experiments show that the IMMRA achieves market efficiency in most instances. The inefficiency occurs occasionally in special cases when cost structures are significantly different among suppliers. Numerical results also show that the IMMRA results in lower buyer payments than the traditional Vickrey-Clarke-Grove (VCG) payments in most cases without significantly hurting market efficiency. (PUBLICATION ABSTRACT)

TEXT: This article studies iterative multi-attribute auctions for multi-unit procurement. Order splitting among suppliers is allowed in auctions to improve efficiency and take advantage of suppliers' cost structures. Suppliers are also allowed to provide discriminative prices over units based on their cost structures. A mechanism called iterative multi-attribute multi-unit reverse auction (IMMRA) is proposed based on the assumption of the modified myopic best-response strategies. Results from numerical experiments show that the IMMRA achieves market efficiency in most instances. The inefficiency occurs occasionally in special cases when cost structures are significantly different among suppliers. Numerical results also show that the IMMRA results in lower buyer payments than the

traditional Vickrey-Clarke-Grove (VCG) payments in most cases without significantly hurting market efficiency.

INTRODUCTION

With the rapid growth of Internet technologies, online reverse business-to-business (B2B) auctions have become common. Online reverse auction mechanisms in the literature fall into three categories: multi-item auctions, multi-unit auctions, and multi-attribute auctions. Between the first two auction forms, multi-item auctions deal with heterogeneous items to be auctioned off while multi-unit auctions treat multiple units of homogeneous goods. Both multi-item auctions and multi-unit auctions focus on price-only negotiations and their optimal solutions find the supplier(s) with the lowest cost. The value of the goods or services for the buyer is assumed to be predetermined and the same, no matter which supplier is chosen as the winner. In reality, in addition to price, other attributes such as quality and other specifications may influence the buyer's value of the goods or services. In this setting, multi-attribute reverse auctions are proposed as electronic request for quotation (eRFQ) buying processes in the auction literature (Strecker and Seifert, 2004) to consider multiple attributions. In an RFQ process, a corporate buyer announces a set of negotiable attributes, such as quality, lead-time, and technical specifications, for the bidding product. Each attribute has several possible levels; for example, lead-time could be one week, half a month, or two months. Potential suppliers are invited to submit bids on one or several attribute-level bundles. The attribute-level bundle is defined as a combination of selections with one and only one level for each product attribute. The traditional RFQ process terminates with an outcome of one winner and a single selected attribute-level bundle. There are two computational challenges in traditional RFQ buying processes: the evaluation of bids for suppliers and the winner determination for the auctioneer (or the buyer) (Parkes and Kalagnanam 2005; Bichler and Kalaganam, 2005).

If the suppliers' marginal costs of each attribute-level bundle are fixed and independent from the quantity, a multi-attribute reverse auction with multiple units is reduced to the single-unit procurement, and a single supplier wins the entire sourcing contract. However, the marginal costs of suppliers, especially in various manufacturing and power industries, are variable because of setup costs, variable costs, capacity constraints, or other factors. Therefore, economies and diseconomies of scale cannot be ignored in analysis of online procurements (Jin et al., 2006). Economies of scale justify procurement agreements with quantity discounts, which are widely considered in the procurement literature (Tenorio, 1999). Hohner et al., (2003) give a realistic case with quantity discounts in procurement auctions. With variable marginal costs, allowing the split of the sourcing

contract among multiple suppliers may achieve more cost-efficient outcomes for both the buyer and the overall system. Jin et al. (2006) provide examples with splitting among suppliers in multiple-unit auctions.

In this article, auctions with multiple attributions and multiple units are considered. An iterative multi-unit, multi-attribute reverse auction mechanism is proposed for multi-attribute procurements with suppliers' variable marginal costs. The mechanism allows the contract to be split among winning suppliers. However, the mechanism requires all winners to provide the products or services with the same attribute-level bundle. Most corporate buyers have this homogeneous requirement (the same level for all attributes) to simplify management, reduce future maintenance cost, and preserve the same add-on values for their customers. Parkes and Kalagnanam (2005) designed an iterative additive and discrete (AD) auction for a special case of the multi-attribute allocation problem with the assumption of additive structure on the buyer's valuation and suppliers' costs. The AD auction quotes prices on each attribute. We generalize it into the auction with bidding on each attribute-level bundle by relaxing the assumptions of additive structure and preferential independence (Keeney and Raiffa, 1993). Introducing the concept of attribute-level bundle increases the computational complexity for suppliers to evaluate their bids but extends the auction to a more general setting. This article formulates a mathematical programming model to optimize the market allocation. The results of computer-based numerical experiments are used to compare the performance of the multiattribute reverse auction with the reverse Vickrey-Clarke-Grove (VCG) auctions.

The following section reviews related work on multi-attribute reverse auctions and multi-unit auctions. The mathematical programming model that solves the winner allocation problem in the proposed multi-attribute multi-unit reverse auction is presented in the following section, followed by a discussion of the details of the mechanism design and theoretical analysis and an example to illustrate the proposed mechanism. Numerical experiment results are presented next and the article concludes with a discussion of the advantages and disadvantages of the proposed auction mechanism and provides future work directions.

LITERATURE REVIEW

In the literature of multi-attribute auctions, Che (1993) first presents twodimensional reverse auctions in which a group of suppliers bid on both price and quality. The bids are evaluated by an ex ante scoring rule announced by the buyer. By defining each supplier's cost structure as an independent increasing function in quality with an unknown parameter, three sealedbid auction mechanisms are developed to maximize the expected buyer profits. With her strong commitment power, the buyer can implement the

optimal scoring rule. Branco (1997) relaxes Che's assumption of independent supplier cost functions and studies the impact of cost correlation on the multi-attribute auctions. Considering Uiree product attributes-price, quality, and lead time-Chen Ritzo et al. (2005) compare the multi-attribute auctions with the price-only auctions. If the quality and lead-time utility functions are known to the auctioneer, the multi-attribute auctions outperform me price-only auctions always on the buyer's profit and occasionally on sellers' profits in the standard English auctions. Beil and Wein (2003) extend Che's auction to a more general iterative mechanism. In meir paper, a supplier's cost function of each attribute is assumed to have P parameters. It is also assumed that the structure of suppliers' cost functions is exposed to me auctioneer while the P parameters are private information held by me suppliers. An iterative auction mechanism with P+ 1 rounds is designed for the auctioneer (the buyer) to derive the P parameters in suppliers' cost functions of attributes. With all revealed information, the buyer determines the optimal scoring functions in the (P+ l)st round to maximize her expected profit. Parkes and Kalagnanam (2005) developed an iterative price-based reverse auction that provides an equilibrium outcome of me modified Vickrey-Clarke-Groves (VCG) auctions. Instead of focusing on the buyer's profits, they consider an efficient design for the market that includes the buyer and all the suppliers. Under the assumptions of additive cost components (Bichler and Kalagnanam 2005) and preferential independence (Keeney and Raiffa 1993), all suppliers submit bids in the forms of additive price parts for each attribute level after evaluating the ask price from the buyer and their own cost structures. By assuming fixed marginal costs, Parkes and Kalagnanam (2005) proposed a single-item multi-attribute auction that can be easily extended to homogeneous multi-unit procurement. For heterogeneous items, the combinatorial allocation problem (CAP) is studied as multi-item auctions in Benoit and Krishna (2001), Rothkopf et al. (1998), Bikhchandani (1999), and others. Bichler et al. (2003) studied multi-attribute reverse auctions in the case of multiple sourcing rather than one single supplier. They also extended the multi-attribute reverse auctions to the concept of configurable offers and developed mathematical models for the winner determination problems under different situations and analyzed the computational complexity. However, there is no discussion about me implemental mechanism design for multi-attribute reverse auctions in their work. Mishra and Veeramani (2002) proposed a descending-price multi-attribute reverse auction mechanism for single outsourcing and studied strategic behaviors of both the buyer and suppliers. The mechanism achieves nearly efficient allocation and nearly competitive final prices. Ronen and Lehmann (2005) proposed a general method for the construction of nearly optimal multi-attribute valid auctions for one-short auctions. To the best of our knowledge, no previous literature has proposed a mechanism for iterative multi-attribute reverse auctions with order splitting among multiple winning suppliers.

Regarding the research of multiple-unit auctions, Harris and Raviv (1981) and Weber (1983) studied several special assumptions under which the traditional single-unit auction can be extended into multi-unit schemes. Teich et al. (1999) presented a traditional multi-unit auction with one seller and multiple buyers and designed an algorithm to reduce the price discrimination. Wolfram (1998) focused on me bidding strategies in multi-unit auctions. Tenorio (1999) first considered a multi-unit reverse auction with nonlinear cost structures of suppliers. Jin et al. (2006) generalized the cost functions in Tenorio's work to a U-shaped curve to capture the economies and diseconomies of scale. By investigating the properties of such multiunit reverse auctions and bidders' behaviors, Jin et al. (2006) developed an iterative auction mechanism with three tie-breaking rules for multiple optimal solutions. The mechanism allows splitting allocations among suppliers.

MULTI-ATTRIBUTE MULTI-UNIT ALLOCATION PROBLEM (MMAP)

This article studies the multi-attribute multi-unit allocation problem (MMAP) and designs a reverse auction mechanism that efficiently allocates multiple units of a certain product with multiple attributes among suppliers with different cost structures. The proposed model relaxes the common assumption that the suppliers' marginal costs for products are constant or monotonic in units. In our study, the suppliers may incur variable marginal costs for their products. We first present a madiematical programming formulation for the MMAP that optimizes product allocation based on market efficiency. The optimal allocation from the perspective of the integrated market is an important criterion for the performance of auctions in commercial procurement. In an industrial outsourcing scheme, repeated buying is common. A sustainable procurement practice requires long-time partnerships between buyers and suppliers. If the auctioneer focuses mainly on maximizing the buyer's profits, the suppliers may be discouraged in the long run. In general, maximizing the integrated market net profits provides an important benchmark. Therefore, this article evaluates the proposed auction mechanism based on the market efficiency and the buyer's payment.

Next, we provide the formulation of the winner determination problem in iterative reverse auctions. This formulation represents the buyer's decision model that maximizes her net profits by optimally determining the winning supplier(s) of each round based on the current submitted bids.

Market Efficiency Model

In the MMAP, a buyer requests D units of a product that has m attributes. The number of possible levels of attribute j∈{l, ... ,m} is defined

as L
sub j

. An attribute-level bundle b is mathematically defined as the set of attribute levels b= {1

sub j

 \j = 1, ... ,m}, where 1

sub j

 ∈{l, ... ,L

sub j

}. Therefore, the total number of possible bundles isfi = nj=1 Lj. For example, suppose a buyer who seeks to procure desktop computers considers the computers' processing speeds and memory as the two main attributes. If there are two levels of processing speed (e.g., 1.66 GHz, 3.0 GHz) and three levels of memory (e.g., 128 MB, 256 MB, and 512 MB), then there are 2 x 3 = 6 possible attribute bundles. It is assumed that n suppliers participate in me auction to compete for the contract. Each supplier can bid for one or multiple bundles. Supplier i ∈{l, ... ,n} incurs the marginal cost c

sub ibk

 to produce the kth ∈{l,... ,D} unit of the product with attribute-level bundle b ∈{l, ... ,B}. The marginal cost structures are private information held only by suppliers. The buyer's unit valuation of attribute-level bundle b is v

sub b

, which is also private information of the buyer. At each iteration, the buyer selects a unique attribute-level bundle for all the products to be purchased. As such, even though the buyer can distribute the winning bids among multiple suppliers, all the winning bids must be from the same attribute bundle. We define a binary variable x

sub b

, which equals one if attribute-level bundle b is selected and zero otherwise. Another binary variable y
sub ik

is one if k units are allocated to supplier i and zero otherwise. Let F

sub i

denote the total production cost for supplier i to produce the allocated units. The following formulation is an integer linear programming (ILP) model that maximizes the market efficiency (ME) through optimal attribute-level bundle selection and demand allocation among suppliers. The model is a modified version of that proposed by Bichler et al. (2003).

Constraint set (1) ensures that the required demand from the buyer is met. Constraint (2) ensures that exactly one attribute-level bundle is selected because the buyer wants to procure homogeneous items. Constraint set (3) ensures that a unique amount is allocated to each supplier. For example, consider the case where a supplier submits three bids for one particular attribute-level bundle: ($2, 2 units), ($3, 3 units), ($4, 5 units). Though the combination of the first two bids is better man the third one for me buyer, it is infeasible because this supplier accepts only $4 each for 5 units. Constraint set (4) determines F
sub i

by imposing a positive right-hand side only if attribute-level bundle b is selected. M

sub ib

serves as a big number in constraints (4), and its value can be determined by Equation (5). When bundle b is not selected (x

sub b

= 0), constraints (4) for bundle b does not restrict me value of F

sub i

. When bundle b is selected (x

sub b

=1), constraints (4) guarantee me cost (charge) of supplier i is F
sub i

= ∑

sub D

sub k=1

y

sub ik

. (∑

sup k

sub r =1

c

sub ibr
) based on me cost structure of supplier i for bundle b.

Winner Determination Problem

Here, F

sub i

represents total payment to supplier i. The model MMAP-BP maximizes the buyer's profit by selecting the lowest-cost suppliers and the best attribute-level bundle. Constraints (6)-(10) indicate the same underlying constraints as those in the model MMAP-ME.

ITERATIVE AUCTION MECHANISM

This section presents an iterative multi-attribute multi-unit reverse auction (IMMRA) mechanism for the MMAP defined previously. At the beginning of the auction, the auctioneer collects unit valuation v

sub b

for each bundle from the buyer. At each round t, the auctioneer sets a flat unit ask price p

sup t

sub b

for each attribute-level bundle regardless of volume. The assumption of a flat unit ask price is based on the fact that each product with a certain

attribute-level bundle has a single unit value for the buyer independent from the volume of the purchase. Maintaining a flat unit ask price simplifies the winner determination problem for the buyer. It also simplifies the suppliers' bid evaluation process. The initial ask price p

sup 1

sub b

at the first round is initialized to be greater than v

sub b

. This encourages higher supplier participation as the competitive suppliers' costs are typically lower than the buyer's valuations and protects the private valuation information of the buyer. At each round t, supplier i submits one or more bids s

sup t

sub ibk

to indicate the acceptable unit price of being allocated k units with attribute-level bundled. At any round, suppliers can change their bidding and may bid for a completely different attribute-level bundle and quantity from the previous round. However, we assume the no-regret rule that the suppliers are not allowed to increase their bids (i.e., ask higher prices) for a specific quantity and attribute-level bundle. This is ensured by defining s

sup t

sub ibk

= min
sub r=i

,..., t {s

sup r

sub ibk

}. The auctioneer solves the winner determination problem MMAP-BP at round t with parameter s

sup i

sub ibk

= s

sup t

sub ibk

. At the next round, ask prices are updated as p
sup b+1

sub b

= min

sub i=1,....,n;k=1,...,D;r=1,...,t

{

sup r

sub ibk

) ≤ P

sup t

sub b

. winning bids of the previous round are retained automatically even if the bidding prices are lower dian the current ask prices. For the losing bids or new quantity and bundle pairs, the prices have to be the same or lower than the current ask price. However, each supplier is offered a last opportunity to place her final bids with prices higher than the current ask prices on any preferred bundles if all prices are higher than her expectation and yield negative profits. Once their final bids are submitted, suppliers cannot change their bids further. The auction terminates if no supplier changes her bids. At the end of the auction, me final winners receive their payments for winning bids based on prices that they have offered at the previous rounds.

Bidding Strategies

The suppliers determine their bids based on their cost structures and the

current ask prices without knowing cost information of other competing suppliers. However, based on the rule of p

sup t+1

sub b

= min
sub i=1,....,n;k=1,...,D;r=1,...,t

{

sup r

sub ibk

) ≤ P

sup t

sub b

, the auctioneer decreases an attribute-level bundle's ask price at round t+ 1 if any supplier submits a bidding price lower than the attribute-level bundle's ask price at round t. Thus, the ask prices reveal partial bidding information of the competition, which subsequendy intensifies me competition among suppliers. To analyze suppliers' bidding strategies in iterative auctions, recent papers on auction mechanisms such as Parkes and Ungar (2000), Gallien and Wein (2005), and Beil and Wein (2003) employ the myopic best response (MBR) concept. The myopic best response is defined as a supplier's best bids at round t that maximize her profits assuming all other suppliers' bids at round t - 1 stay unchanged (Parkes and Ungar, 2000). Under this assumption, in single-unit auctions, the suppliers are assumed to act as if round t is the last round before the auction terminates as no other suppliers are expected to change their bids. This assumption is reasonable for single-unit auctions. However, multi-unit auctions may have multiple provisional winners at round t- 1. As such, a supplier may need to change her bids more man once to achieve her highest utility, even if other suppliers keep their bids unchanged. Therefore, assuming that round t will be the last round before termination is unreasonable in multi-unit auctions. To account for this problem, we define a modified myopic best response (MMBR).

DEfiNTTlON 1. Modified myopic best response (MMBR) is the supplier's best bidding strategy for round t and the following rounds to maximize her final profits, assuming that other suppliers do not change their bids beyond

round t - 1.

The detailed proof to Theorem 1 is provided in the appendix. If supplier i is not a winner at round t, then F

sub i
t* - ∑

sup kt*

sub i

sub r=1

 c

sub ib

sup t*r

 = 0 since no unit is allocated to her (i.e., k

sup t*

sub i

 = 0, F
sup t*

sub i

 = 0). The first condition of Theorem 1 is satisfied if the losing supplier has a positive U

sup t+1

sub max i

. She will place a bid on all pairs of (b, k) that incur the largest positive utility at the prices e below the ask prices of round t+ 1. If supplier i is a winner at round t (i.e., k

sup t*

sub i

> 0, F

sup t*
sub i

> 0), F

sub i

t* - ∑

sup kt*

sub i

sub r=1

c

sub ib

sup t*r

≥ U
sup t

sub max i

must be true so that me bids at round t can be justified. Since p

sup t+1

sub b

≤ p

sup t

sub b

is always true, the first condition of Theorem 1 is violated for mis winning supplier. As such, the MMBR bidding strategy for a winner is to retain the bids from the previous round automatically and submit no new bids. Theorem 1 provides the MMBR bidding strategy. All the following analyses and numerical experiments are based on this MMBR bidding strategy. For an inactive supplier i at round t (i.e., U

sup t

sub max i

= max

sub ∀b, ∀k

{(p

sup t

sub b

- ε) . k - ∑

sup k

sub r=1
c

sub ibr

), if she is a winner, the bids submitted by her are retained automatically. However, when the inactive supplier is a loser, she is no more competitive compared to her opponents. In such a case, she releases her final bids with bidding prices above the ask prices. The auctioneer recognizes the bids higher than the current ask prices as final bids. Once a supplier submits final bids, she is not allowed to change her bids any more. Therefore, for final bids, the supplier is assumed to bid on every pair (b,k) with minimum integer q > 0 that satisfies (p

sup t

sub b

+ q . ε) . k - ∑

sup k

sub r=1
c

sub ibr

> 0 to increase her winning possibility. Based on the no-regret rule, once a feasible allocation incurs at one round, it is retained if there is no better one. As long as no feasible allocation arises, all suppliers act as losers to continue decreasing the ask prices until final bids are submitted. Based on the assumption of final bids, it is guaranteed that the auction will terminate with a feasible allocation if one exists. We note that the final bids may reveal partial information regarding the bidding supplier's marginal costs. In practice, these final bids are recorded by the auctioneer, who has the responsibility to protect the privacy of all players.

An Illustrative Example

Consider a buyer who is to purchase three desktop personal computers. The buyer is specifically interested in two attributes of the computers. One attribute is the processor, which has two levels as 2.66 GHz and 3.0 GHz. The other attribute is the memory, with two levels as 256 MB and 512 MB. There are four possible attribute-level bundles that can be provided by three suppliers as listed in Table 1. Both the buyer's unit valuation for each bundle and the suppliers' marginal costs to produce each unit of every attribute-level bundle are given in Table 1.

Based on the buyer valuation and the supplier cost information, we can employ the model MMAP-ME to solve the winner allocation problem using any optimization solver (such as ILOG CPLEX). The optimal solution selects the bundle of (3.0 G Hz, 512 MB) with the allocation of (0, 1, 2), indicating diat supplier 1 wins nothing, supplier 2 wins 1 unit, and supplier 3 wins 2 units, respectively. The maximum market gain from this trade is:

(3)($60) - ($16) - ($17 + $18) = $129

The IMMRA for mis example is simulated in Table 2. In the table, each column is for one bundle and each row has the ask price and bids from three suppliers, including prices and amounts, at each round. The minimum decrement ε is set to $6. In reality, this value could be as small as $1. Since most online auctions are implemented by computer agents automatically (Strecker and Seifert, 2004), the number of rounds is not a considerable computational issue and, dierefore, the decrements can be kept small. The initial ask prices are set to p
sup 1

sub b

= v

sub b

+ ε. All the suppliers follow the bidding strategies as described previously. At each round, the auctioneer solves the MMAP-BP model to determine the optimal attribute-level bundle and allocation. In case of multiple optimal solutions, the winners of the last round are favored. In the following IMMRA example, bids are expressed as s(k) under preferred attribute-level bundles from suppliers, where s indicates the bid price and k is the desired unit under the price. There might be multiple desired units that yield the same potential profits to the supplier, which is expressed as s (k

sub 1

, k
sub 2

, ...).

Table 1. An instance of the multi-attribute problem with two attributes and three units

Round 1. Initial prices are set to be ε = 6 greater than the values of the buyer. Initial bidding prices from the suppliers are determined based on condition (12). All suppliers bid at price $66 on attribute-level bundle 4 of 3 units (i.e., the pair of (4, 3)) since this pair provides the maximal utility to every supplier. Supplier 1 is arbitrarily selected to be the winner.

Table 2. An IMMRA example

Table 2. An IMMRA example

Round 2. Winning supplier 1 keeps the same bids. Losing suppliers 2 and 3 update their bids following Theorem 1. If they decrease the ask prices by ε = 6 for all pairs, their maximal utilities still occur on the pair of (4, 3). Therefore, both suppliers 2 and 3 bid at $60 on pair (4, 3). Solving the winner determination problem MMAP-BP, supplier 2 is selected to be the winner.

Rounds 3-15. Ask prices are updated to match the lowest bidding prices at the last round. Following Theorem 1, losing suppliers update their bids, while winners keep their bids unchanged. A provisional allocation of (0, 1, 2) is the result of round 15 with attribute-level bundle 4 selected.

Rounds 16-17. If the current ask prices are reduced by $6 more, the maximum utility is negative for every supplier. Suppliers 2 and 3, who are winners,

stay on their current bids. However, the loser, supplier 1, who is inactive, submits her final bids. The bids marked in bold that are higher than the ask prices are recognized as final bids by the auctioneer. Therefore, supplier 1 is forbidden to update her bids anymore. Consequently, the auction terminates with bundle 4, and the payments of (0, $ 18, $36) to the three suppliers are made respectively.

To evaluate the outcome payments further from the simulated IMMRA, we use the traditional Vickrey-Clarke-Groves (VCG) payment as a benchmark. Although the VCG auction is seldom or never used in practice (Rothkopf et al. 1990), the VCG auction is a good benchmark because it is the only mechanism for which an equilibrium strategy (in the Nash sense) has been computed and the efficiency of the allocation can be maximized (Milgrom, 2004). Please note that there is typically a conflict between two major goals of auction mechanism design: market efficiency and revenue maximization (for forward auction; Ausubel and Cramton, 1999). In the following section, bom goals will be investigated to evaluate the proposed IMMRA.

Let Z* denote the optimal value of the model MMAP-ME. Z

sub -i

is the alternative optimal value without supplier i. The marginal value of supplier i is defined as Z* - Z*

sub -i

, which is her contribution to the market. The VCG mechanism terminates with a payment of the winner's marginal value plus her cost. Thus, a winner's profit is computed as her marginal value. In this example, marginal value of supplier 2 is calculated as Z* - Z*

sub -2
= $129 - $127 = $2, while that of supplier 1 is calculated as Z* - Z*

sub -i

= $129 - $128 = $1. Therefore, the VCG payments to suppliers 2 and 3 are $16(cost) + $2(margin) = $18 and $35(cost) + $1 (margin) = $36, respectively. In this example, the IMMRA has the same payments as the VCG auction. In the next section, more numerical experiments are conducted to compare the performance of the IMMRA to that of the VCG auction. The analysis shows that the IMMRA terminates with lower payments man the VCG auction does in most cases.

EXPERIMENTAL RESULTS AND DISCUSSIONS

Numerical experiments are conducted on a problem with 4 suppliers, 4 attributes, and 4 levels per attribute. It is assumed that the suppliers follow the strategies described previously throughout the auction. In me experiments, data are generated randomly with two positive parameters α

sup Sell
and α

sup Buy

. A weight w

sub b

~ U(0,1) is randomly selected for each attribute-level bundle b. All weights are normalized to satisfy ∑

sup B

sub b=1

w

sub b

= 1. For the buyer's valuation, we randomly generate B values from U(0, α
sup Buy

. B) and sort these values. Sorted values are multiplied by the weight w

sub b

to generate the buyer's valuation v

sub b

for attribute-level bundle b. For suppliers' marginal costs, we first create the mean value c

sub ib

over all units similarly as the buyer's valuation. For supplier i, B

random values are generated from U(0, α

sup Sell

. B). These values are sorted and multiplied by the normalized weight Wb
to generate c
sub ib

. For supplier i, D coefficients are randomly generated from u

sub k

~ U(-0.5,0.5) for each bundle to compute the marginal cost as c

sub ibk

= c

sub ib

+ c

sub ib

. u

sub k
. The two constants are chosen to satisfy α

sup Buy

≥ α

sup Sell

to guarantee that the buyer's valuation for a bundle is greater than the
marginal cost of an average supplier. In the experiments, we set α

sup Buy

= 30 and α

sup Sell

= 40 by default. Table 3 shows the performance comparison of me VCG
auction and the IMMRA for 20 instances with me minimal bid decrement of $1.

In the results listed in Table 3, 2 out of 20 instances yield inefficient system utility marked in bold and italics. To further verify the efficiency of IMMRA, we run the experiments for 100 instances and get 27 cases with inefficient solutions. In other words, 73% of the instances result in efficient allocations and the best bundle selections for the market.

We study the following simple case that does not result in the first best solution for the market under the proposed IMMRA procedure to investigate the underlying reasons of me inefficiency. Suppose the buyer wants to procure three units of a product with two attribute-level bundles. Three suppliers are involved in the auction to compete for the order. The buyer's valuations and suppliers' marginal costs are provided in Table 4. The simulation of IMMRA is conducted round by round in Table 5 with the minimal decrement of $10. Solving the optimization model MMAP-ME, we show that the efficient solution is to allocate 3 units to supplier 1 with bundle 1. However, the outcome of the auction selects bundle 2 with the same allocation. In this case, the system utility is degraded from the optimal value of $114 to $92.

Table 3. Comparison of IMMRA and the VCG auction

At rounds 6 and 7, supplier 2 reduces her bidding prices of 2 units or 1 unit for bundle 1. She is not selected to be a winner because no feasible solution including her bids exists. However, the buyer's ask prices are triggered to decrease because of the lowest bidding prices from supplier 2. Supplier 1 automatically retains her bids as a provisional winner. Therefore, at round 8, bundle 1 with an ask price at $40 is no longer the best choice for supplier 1 to improve her bids based on Theorem 1. After supplier 1 reduces her bidding price for bundle 2 to $50, supplier 2 is no longer competitive and has to submit her final bids. The auction terminates with the outcome of allocating 3 units to supplier 1 and selecting bundle 2. This situation occurs when the ask prices for the efficient bundle decrease too quickly because a losing supplier has a very low production cost for an amount that is less than the demand and her bids for mat bundle do not lead to a feasible allocation for the buyer. Nevertheless, the ask price is still decreased due to diminishing bids. Meanwhile, there exists anotiier competitive bundle with a better utility for the previous winner for which me best feasible allocation is achieved. Consequently, the ask prices that are decreased inefficiently lead to less-than-optimal results.

Table 4. An inefficient instance

Table 5. An inefficient IMMRA example

The primary purpose of the buying corporations to participate in online

auctions is to save costs. The numerical analysis reveals that, under the IMMRA mechanism, auctions terminate with lower payments to the winners compared to the VCG auctions in most instances. In the experimental results, we observe that the buyer saves money in procurement costs by participating in IMMRA in 80% of all instances. Recall that the VCG payment to supplier i is defined as the margin value Z* - Z*

sub -i

. Here, Z*

sub -i

indicates the optimal market utility based on the optimal allocation in the absence of supplier i. This allocation is the second best solution in a single item multi-attribute auction. However, since we allow the order split in the IMMRA, which considers multiple units, the second best solution may still include supplier i as a winner with different winning allocation. Therefore, the IMMRA may result in a payment less than the margin value Z* - Z*

sub -i

because of a better second-best solution that includes supplier i. If the second-best solution for the IMMRA does not include any winning supplier from the best allocation, the payment to the winners should be at least as good as the VCG payment when me minimal decrement e approaches zero. The four payments marked in bold and italics in Table 3 are greater than the VCG payments because the minimal decrement s is insufficiently small. Please note that the transaction costs are not included in the numerical experiments.

CONCLUSIONS

The iterative multi-attribute multi-unit reverse auction (IMMRA) is proposed in this article for procurement auctions involving multiple units of products or services with a series of negotiable attributes in addition to price. The goal of the proposed mechanism is to incorporate the suppliers' variable marginal costs efficiently in the multi-attribute reverse auctions, where suppliers prefer to bid with discriminative prices over units and buyers can split their purchases among bidding suppliers. Under this mechanism, splitting the procurement contract to more than one supplier often leads to higher buyer profits. To our knowledge, our work is the first to investigate the mechanism design of a multi-attribute auction that allows for multiple unit procurement with order splits.

We first proposed an integer programming model for the IMMRA to solve the winner determination problem. To study the bidders' behaviors, we tailor

the myopic best response (MBR) approach for the multi-attribute case and develop the modified myopic best response (MMBR). The latter approach ensures a proper bidding strategy for the order-splitting situation in the proposed IMMRA mechanism. The suppliers' MMBR bidding strategies for the IMMRA are discussed in detail and illustrated previously. The experimental results show that the market efficiency is achieved in most instances. The inefficiency occurs occasionally for special cases where bidding suppliers have significantly different cost structures. Numerical results show that, in general, the buyer pays less in the IMMRA mechanism compared to the VCG payments.

In the future, it will be interesting to study the information revelation and computational complexity issues of the IMMRA discussed in this article. Fixing the inefficiencies that were observed in the experimental results is another interesting future topic. One solution is to allow the auctioneer to maintain discriminative ask prices over units. This means that we may avoid the excess price reductions on the efficient allocation but increase the computational complexity. Another interesting future direction is to relax the assumption for placing the final bids and find out a more robust bidding strategy without compensation of efficiency.

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APPENDIX

APPENDIX

...ABSTRACT: units based on their cost structures. A mechanism called iterative multi-attribute multi-unit reverse auction (IMMRA) is proposed based on the assumption of the modified myopic best-response strategies. Results from numerical experiments show that the IMMRA achieves market efficiency...

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...each attribute-level bundle are fixed and independent from the quantity, a multi-attribute reverse auction with multiple units is reduced to the single-unit procurement, and a single supplier wins...

...in various manufacturing and power industries, are variable because of setup costs, variable costs, capacity constraints, or other factors. Therefore, economies and diseconomies of scale cannot be ignored in analysis of...

...cost structure as an independent increasing function in quality with an unknown parameter, three sealedbid auction mechanisms are developed to maximize the expected buyer profits. With her strong commitment power, the...

...on sellers' profits in the standard English auctions. Beil and Wein (2003) extend Che's auction to a more general iterative mechanism. In meir paper, a supplier's cost function of...

...suppliers' cost functions is exposed to me auctioneer while the P parameters are private information held by me suppliers. An iterative auction mechanism with P+ 1 rounds is designed for the auctioneer (the buyer) to derive the...

...all revealed information, the buyer determines the optimal scoring functions in the (P+ l)st round to maximize her expected profit.
Parkes and Kalagnanam (2005) developed an iterative price-based reverse auction that provides an equilibrium outcome of me modified Vickrey-Clarke-Groves (VCG) auctions. Instead of focusing on the buyer's profits, they consider...

...By assuming fixed marginal costs, Parkes and Kalagnanam (2005) proposed a single-item multi-attribute auction that can be easily extended to homogeneous multi-unit procurement. For heterogeneous items, the combinatorial allocation problem (CAP) is studied as multi-item auctions in Benoit and Krishna (2001), Rothkopf...

...auctions in their work. Mishra and Veeramani (2002) proposed a descending-price multi-attribute reverse auction mechanism for single outsourcing and studied strategic behaviors of both the buyer and suppliers. The...
...me competition among suppliers. To analyze suppliers' bidding strategies in iterative auctions, recent papers on auction mechanisms such as Parkes and Ungar (2000), Gallien and Wein (2005), and Beil and Wein...

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DEfiNTTlON 1. Modified myopic best response (MMBR) is the supplier's...
? T S2/3,K/1-5

2/3,K/1   (Item 1 from file: 15)
DIALOG(R)File 15:ABI/Inform(R)

03326292 1407095951
ITERATIVE MULTI-ATTRIBUTE MULTI-UNIT REVERSE AUCTIONS
Zhang, Zhuoxiu; Jin, Mingzhou
Engineering Economist v52n4 PP: 333-354 2007
ISSN: 0013-791X JRNL CODE: EEC
WORD COUNT: 6618

...TEXT: suppliers' cost functions is exposed to me auctioneer while the P parameters are private information held by me suppliers. An iterative auction mechanism with P+ 1 rounds is designed for the...

...all revealed information, the buyer determines the optimal scoring functions in the (P+ l)st round to maximize her expected profit. Parkes and Kalagnanam (2005) developed an iterative price-based reverse...

...By assuming fixed marginal costs, Parkes and Kalagnanam (2005) proposed a single-item multi-attribute auction that can be easily extended to homogeneous multi-unit procurement. For heterogeneous items, the combinatorial allocation problem (CAP) is studied as multi-item auctions in Benoit and Krishna (2001), Rothkopf...

2/3,K/2 (Item 2 from file: 15)
DIALOG(R)File 15:ABI/Inform(R)

01825955 04-76946
Private property, economic efficiency, and spectrum policy in the wake of the C block auction
Fritts, Brian C
Federal Communications Law Journal v51n3 PP: 849-885 May 1999
ISSN: 0163-7606 JRNL CODE: FCL
WORD COUNT: 15171

...TEXT: because it means that the individual license is more valuable depending upon whether the user holds licenses for the contiguous area. This means that it is more efficient for some bidders...

...bidder to have better information on what bids it can match unlike a sealed bid auction where bidding is blind.'g5

The FCC is experimenting with combinatorial bidding, which should be implemented if found to increase the efficiency of auction allocation. In short, combinatorial bidding allows an entity to enter a package bid for a group of licenses.'86...

2/3,K/3 (Item 1 from file: 20)
DIALOG(R)File 20:Dialog Global Reporter

23765893 (USE FORMAT 7 OR 9 FOR FULLTEXT)
Net Exchange Advanced Combined Value Trading Framework Selected for Schneider Logistics' SUMIT CVA Procurement System
BUSINESS WIRE
July 08, 2002
JOURNAL CODE: WBWE LANGUAGE: English RECORD TYPE: FULLTEXT

WORD COUNT: 709

... that comprise commerce. In May 1994, faculty from the California Institute of Technology formed Net Exchange to commercialize solutions based on advanced research in computational combinatorial trading. These solutions marry planning optimization techniques with commerce execution and help firms to increase...

2/3,K/4 (Item 1 from file: 2)
DIALOG(R)File 2:INSPEC

10300167
Title: Simulating combinatorial auctions with dominance requirement and loll bids through automated agents
Author(s): Avenali, A.; Bassanini, A.
Author Affiliation: Dipt. di Informatica e Sistemistica, Univ. degli Studi di Roma "La Sapienza", Italy
Journal: Decision Support Systems vol.43, no.1 p.211-28
Publisher: Elsevier,
Publication Date: Feb. 2007 Country of Publication: Netherlands
CODEN: DSSYDK ISSN: 0167-9236
SICI: 0167-9236(200702)43:1L.211:SCAW;1-Z
Material Identity Number: F773-2007-001
DOI: 10.1016/j.dss.2006.09.008
Language: English
Subfile: C D

Abstract: When complementarity or substitutability relations exist among the items for auction, the use of combinatorial bidding (i.e. permitting players to bid on bundles of items) enhances the seller's revenue and ex-post market efficiency. We present a new first-price multi-round combinatorial format, where bids are subject to a stronger requirement than validity, and a new...

... on simulation results, obtaining useful hints for the design of ascending combinatorial formats. [All rights reserved Elsevier].

2/3,K/5 (Item 2 from file: 2)
DIALOG(R)File 2:INSPEC

09336659 INSPEC Abstract Number: C2005-05-7120-017

Title: Oblivious comparator and its application to secure auction protocol
Author(s): Kikuchi, H.
Author Affiliation: Dept. of Inf. Media Technol., Tokai Univ., Japan
Journal: Transactions of the Information Processing Society of Japan vol.45, no.8 p.1898-907
Publisher: Inf. Process. Soc. Japan,
Publication Date: Aug. 2004 Country of Publication: Japan
CODEN: JSGRD5 ISSN: 0387-5806
SICI: 0387-5806(200408)45:8L.1898:OCAS;1-O
Material Identity Number: T205-2004-011
Language: English
Subfile: C
Copyright 2005, IEE

...Abstract: mix-and-match is that the proposed protocol does not require any involvement of key holders to evaluate function, while the mix-and-match needs key holders to perform threshold decryptions at every step of evaluation of Boolean gates. One disadvantage of...

... 1999). This paper presents an efficient construction for a primitive called `oblivious comparator' with n-round complexity between the comparator and n players but the bandwidth spent by one communication is...

... auctioneer communicates with bidders once at time, and performs evaluation without help of trusted key holders. In addition, the proposed construction allows arbitrary complicated functions including a search for second highest, a resolution the winner, and a dynamic programming (for combinatorial auction).
? T S5/7,K/2-3
>>>Item 2 is not within valid item range for file 608
? T S2/7,K/2-5

2/7,K/2 (Item 2 from file: 15)
DIALOG(R)File 15:ABI/Inform(R)

01825955 04-76946
Private property, economic efficiency, and spectrum policy in the wake of the C block auction
Fritts, Brian C
Federal Communications Law Journal v51n3 PP: 849-885 May 1999 CODEN: FCLJDK ISSN: 0163-7606 JRNL CODE: FCL
DOC TYPE: Journal article LANGUAGE: English LENGTH: 37 Pages
WORD COUNT: 15171

ABSTRACT: In the original spectrum auctions of Personal Communications

Services, the FCC designated a portion of the spectrum for woman and minority-owned small businesses. The Supreme Court's decision in Adarand v. Pena caused the FCC to redesign the auction with the result that many bidders overvalued this spectrum. Due to this overvaluation, many bidders could not meet their obligations to the FCC. FCC auction history and the FCC's response to the original C block auction are analyzed, and suggestions on fixing these within the given congressional and FCC framework are discussed. It is argued that the best solution would be to treat spectrum like private property.

TEXT: (Table Omitted)
(Table Omitted)

But if some of the consequences of his action are outside of the sphere of the benefits he is entitled to reap and of the drawbacks that are put to his debit, he will not bother in his planning about all the effects of his action. He will disregard those benefits which do not increase his own satisfaction and those costs which do not burden him. His conduct will deviate from the line which it would have followed if the laws were better adjusted to the economic objectives of private ownership.

I. INTRODUCTION

The most efficient means of distribution of scarce goods is private ownership. When private ownership is either expressly allowed or government-use rules closely resemble private property, the good is put to its most highly valued use. Rules of private property are especially necessary when valuation of the commodity is unclear. When the efficiency of private property exists, holders of goods must account for the goods' costs. The failure to create efficient rules by financing outside of private capital markets and the failure to properly institute property rights in spectrum created the current problems with the C block spectrum auctioned off by the Federal Communications Commission (FCC or Commission). As part of the 1993 Budget Act, the FCC was given the power to use auctions in awarding licenses for spectrum use.2 The original C block spectrum auctions began December 18, 1995, and concluded May 6, 1996.3 The C block auction was for a designated portion of the spectrum called Personal Communications Services (PCS). Personal Communications Services networks provide users with wireless data transmissions, voice transmissions, and electronic mail. Personal Communications Services is expected to offer less expensive services with stronger connections.4

Unlike the previous A and B block auction, reserved and dominated by large bidders such as PrimeCo, Sprint Corporation, and AT&T Corporation, the C block auction was unique because it targeted smaller businesses that, in some cases, outbid large bidders by up to three times the A and B block

amount.5 In the short term, the C block auction appeared a resounding success. By offering favorable terms to those companies qualifying under FCC guidelines as a small business, the bidding resulted in a frenzy that drove up auction revenue. By the time the C block auction concluded, the total amount bid for the C block was $10.2 billion.6 This was more than double the revenue of the A and B blocks combined.7 For reasons explained in this Note, the A and B block licensees paid an average price of $16 per person covered in a territory (POP), while C block licensees bid more than $40 per POP for a winning spectrum bid.8
While C block participants bid higher prices for spectrum, big bidders who entered the market first achieved greater economies of scale than newer companies. For instance, it was estimated that Sprint may have a 30 percent cost advantage over smaller companies.9 This advantage is accomplished because a company like Sprint can use national advertising at 50 percent the cost per viewer than a smaller company using local advertising.10
Economies of scale are not the sole problem for small bidders. Even though conditions in the capital markets have been favorable, there was a 70 percent plunge in values of comparable debt and equity issuers.11 Wall Street analysts have estimated the fair market value of the C block at $10 per POP, making it difficult for small bidders to raise the funds needed to build the necessary infrastructure for their networks.12

This led to the current problem. The C block rules required only a 10 percent down payment and then allowed payments to be made over ten years.13 When those payments came due, C block licensees had trouble meeting their obligations. In fact, three bidders filed for Chapter 11 bankruptcy protection. General Wireless, which sought Chapter 11 protection, still owes the FCC over $953.6 million for its PCS licenses,14 Pocket Communications, Inc., which bid $1.4 billion, asked for federal protection in March of 1996,15 and NextWave filed for bankruptcy protection on June 8, 1998.16 This turn of events concerning the C block forced the FCC to offer a plan for auction winners to return spectrum to the FCC if necessary. This spectrum was reauctioned in March 1999.17

This Note argues that the primary focus of the FCC should be the efficient distribution of property rights in spectrum. Efficiency in this context means spectrum should be placed into the hands of the company or person who values it most. This implies that the only goals of the FCC should be to conduct auctions in an efficient manner and to grant winners an ownership interest equivalent to private property that will be enforced by the FCC.18The C block auction demonstrates the difficulties that are encountered when the FCC deviates from efficiency as a standard.

To properly discuss the relationship between efficiency, the FCC, and spectrum policy, there are several issues that must be raised. First, why did the FCC first move to an auction format to distribute spectrum? Second,

what goals was the FCC trying to accomplish by giving advantages to small businesses? Third, what went wrong with the auction, and what attempts have been made to fix it? This Note next suggests ways to fix the C block problem within the given framework. Lastly, what exactly is efficiency, how does it relate to a value-driven policy, and what would an efficient spectrum policy look like? This Note's contention is that the best and most efficient means of distributing the spectrum is an auction where payment is required shortly after the winning bid is selected. Efficiency requires that the highest bidder win the auction and that spectrum rights be transmissible. It is this Note's contention that efficient spectrum policy requires broadening property rights related to spectrum. This would include the right to use the spectrum in whatever manner the owner deems to be in his or her best interest.

II. A BRIEF HISTORY OF FCC DISTRIBUTION OF SPECTRUM 19

A. Comparative Hearings and Lotteries Not all spectrum is available for public use. "Frequencies in the radio spectrum are divided between federal and nonfederal use."Zo While the National Telecommunications and Information Administration (NTIA) allocates and assigns spectrum to federal users, the FCC has the responsibility of managing the nonfederal part of the spectrum.2' For a long period of time, the FCC managed and distributed the spectrum by means of comparative hearings.22 Comparative hearings employed a standard of the "public interest, convenience, or necessity" in granting spectrum licenses.23 The advantage of a comparative hearing was that it gave an applicant a quasi-judicial forum to argue its qualifications for spectrum over competitors.24 However, the hearing also had the drawback of being inefficient. First, no guarantee existed that the competitor who valued the spectrum most would be awarded it. Second, the procedure was costly to administer. For example, original licenses for cellular services were awarded by comparative hearings. Cellular services were in high demand since they were a scarce resource. The FCC received over 200 requests for the first thirty licenses.25 Many of these requests contained over 1,000 pages of documentation and arguments supporting their claims for licensure. The next round of licensing garnered 344 applicants, while the third round attracted 567 applicants.2 The Commission's resources, especially its time, were strained by the daunting task of reviewing and evaluating applications in an equitable manner. Delay was also a problem during the evaluation process. The process could last longer than two years, causing large opportunity costs. These problems forced the FCC to consider lottery assignments of spectrum as a superior distribution method and to ask Congress for that authority.28 In 1981, section 309(i) was included in the Communications Act.29 The process of a lottery was meant to make the distribution process cost less while also taking less time than comparative hearings.30 The problem with the lottery system adopted by the FCC, however, was that any person or entity could submit an

application if it paid the application fee and met minimal requirements.31After applications were submitted, the FCC would select the winner of the license at random. Such a system immediately encouraged speculation by those not interested in creating cellular phone systems. Because the FCC abandoned its application screening process in 1987, almost 400,000 firms claimed to provide spectrum in order to obtain licenses. 32 A significant secondary market emerged from the lottery system used by the FCC. While the initial license almost never went to the entity that valued it most, the absence of anti-trafficking restrictions eventually allowed the market to allocate licenses to the most valued user. This secondary transaction created a large incentive for rent seeking regarding the windfall profits that could be made on a secondary sale.33 The price of an application being low, a large incentive for speculation was reaffirmed. Despite these drawbacks, there is a part of the lottery system that was efficient-eventually licenses went to firms that valued them most. The downside, what made the lottery inefficient, was transaction costs associated with the process. Transaction costs for the year 1991 were estimated to be $190 million.34 The main cost was associated with the time it took the license to be delivered to its highest valued user. On average, this was about two years.35 Since during the delay, the eventual user/customer was denied service, the social cost of the lottery system was quite high. One estimation of social cost for the ten-year delay in licensing of cellular providers was 2 percent of Gross National Product (GNP).36

Both comparative hearings and the lottery system overburdened the ability of the FCC to distribute spectrum efficiently.37 Comparative hearings were wasteful because the amount of effort put into the process was detailed and time consuming. Comparative hearings also failed in the end to give spectrum to the highest valued user. On the other hand, the lottery was inefficient because the time it took to distribute licenses in the secondary market created a large social cost. In addition, the large amount of speculation caused the cost of license application production to rise to nearly $300 million.38 It should be noted that both systems failed to raise revenue for the government. In the lottery system, the profits went to the few speculators who were fortunate enough to win a piece of the spectrum. Comparative hearings failed to raise revenue because the FCC did not receive valuable consideration for the spectrum distributed. B. Auctions In general, the move to an auction format for spectrum distribution has been relatively successful. During the first four years of spectrum auctions, 4,300 licenses were awarded to auction winners who are, or will be, providing service to the public.39 Revenue from the spectrum auctions during that four-year period totaled $23 billion with $12 billion already collected by the U.S. Treasury.40Of the licenses awarded, 53 percent were awarded to small businesses following the tone of 47 U.S.C. 309(j). This success led Congress to extend auction authority until 2007, encompassing

more radio spectrum. Most important to the intent of Congress is that auction costs tend to ward off speculators. Revenue raised by auctions is collected by the Treasury, whereas revenue under a lottery system goes to speculators. Auction winners, those who value the spectrum most, are more likely to implement services quickly. The FCC has broad authority to experiment with bidding techniques to protect the public interest and promote certain objectives of Congress. These objectives include the development and deployment of technology and services in a speedy fashion, diverse spectrum licensees to spur economic development and competition, and recovery of the commercial value of the spectrum for the public.42 Also, a stated objective is the efficient use of spectrum. These goals and objectives are reflected in FCC auction design.

A successful auction of spectrum should result in an efficient distribution of this scarce resource to those who are willing to pay the highest price.43 Of particular importance to the design of FCC spectrum auctions was the allowance for license aggregation and the prevention of collusion in the bidding process.44The nature of the market makes license aggregation a prime consideration for potential bidders. The desirability of license aggregation can be demonstrated by the cellular service needs of the average consumer. When a person is driving in a car throughout a geographical area, he or she does not want to lose service. One solution would be for the cellular user to contract with several providers in an area, but this would entail the high transaction costs of contracting with different providers. The best solution would be for a provider to aggregate service over a given area. Aggregation of licenses can be accomplished by two means. The first is by geographic area.45 A company may wish to purchase many contiguous geographic areas on the same frequency band to offer seamless service to customers. This would also allow a company to pool marketing costs and bargain for band use on the border of a geographic region.46 Second, a firm may wish to aggregate frequency bands within a given geographic area in order to increase the company's bandwidth. By designing an auction encouraging license aggregation, development of new technologies and services becomes feasible where it would otherwise not be within a limited license framework. Firms developing new technologies or services would not be able to recoup development costs without servicing a broad area. The other general objective of an auction design is to prevent collusion. It is difficult to prevent collusion because bidders need to have information on other participants' bidding behavior.47 Larger amounts of information available to all participants create a more efficient auction because bids are more likely to reflect a participant's actual valuation.48 When various participants obtain more information on a competitor's bidding behavior, the opportunity to collude with other participants increases. This dual-edged sword characterization resulted in the strict FCC rules preventing collusion. Firms that applied for the right to bid for common markets were prohibited from discussing, collaborating,

disclosing their bidding strategies, or revealing the substance of their bids.49 The FCC also relied on existing antitrust laws to keep bidders from colluding.5 Auction applicants were required to and still must identify parties with whom they have joint ventures, partnerships, or other agreements.5' Parties are then restricted in communicating bidding strategy to only these firms.52 The primary auction used by the FCC for spectrum distribution is the Simultaneous Multiple-Round Auction.53 The auction's format is as follows: (1) Interdependent spectrum licenses with the potential for substantial aggregation or substitution are grouped and sold at the same time. (2) All bidders submit bids over a sequence of rounds. (3) At the end of each round, the high bid for each license determines who would be the winner of that license if no higher bids were later received, and also helps fix minimum acceptable bids for the next round.

(4) Bidders that fail to submit bids in a round and do not have sufficient standing high bids risk losing eligibility to submit bids in later rounds.

(5) All licenses remain open for bidding until bidding has ceased on all licenses. Before the auction begins, sufficient up-front payments are made for the licenses sought. This form of auction provides more information to bidders about the values of other licenses and allows them to shift their bidding to other licenses.55 The Simultaneous Multiple-Round Auction is only effective if rules are developed to allow withdrawals, stopping, and certain mandatory activity levels. This auction framework has been successful when the ability to pay for the winning bid is established by the participant, but as will be seen by the special designation for the C block auction, it can fail when the FCC allows outside non-economic normative values" to affect its payment program. III. THE FCC'S GOALS IN THE C BLOCK AUCTION The fear exists that a pure auction may not create sufficient opportunities for minority, woman-controlled firms and small businesses. This was the primary concern in creating the C block auction. Congress expressed this concern in section 309(j)(3)(B) of the Communications Act by requiring the FCC to avoid "excessive concentration of licenses and by disseminating licenses among a wide variety of applicants, including small businesses, rural telephone companies, and businesses owned by members of minority groups and women."ss Congress was concerned that a pure auction might result in an increased concentration of the telecommunications industry with fewer firms, thus reducing competition.59 A. Before Adarand Constructors, Inc. v. Pena Originally therefore, the FCC created special designations for the C block. Bidders were qualified to participate if they had gross revenues not exceeding $125 million in each of the prior two years and total assets of less than $500 million at the time of application.60The FCC also developed special rules for woman and minority-owned businesses. While small businesses that had revenues for each of the past three years could receive a bidding credit of 10 percent.61woman and minority-owned businesses received a bidding credit

of 15 percent.62 Businesses that qualified under both categories would receive a 25 percent bidding credit.63 In addition to bidding credits, installment payment plans were instituted by the FCC. If an applicant qualified for the C block auction and bid for licenses in the fifty largest Basic Trading Areas (BTAs), then it could obtain an installment payment plan.. A company also qualified for the installment plan if it had less than $75 million in gross revenues.65 Finally, a special installment method for payment was planned for all women and minority-owned businesses with winning bids. B. Post-Adarand Changes in FCC C Block Policies On June 12, 1995, the Supreme Court decided Adarand Constructors, Inc. v. Pena.67 Adarand significantly impacted the structure of the C block auction. The Court held: "[A]ll racial classifications, imposed by whatever federal, state, or local governmental actor, must be analyzed by a reviewing court under strict scrutiny. In other words, such classifications are constitutional only if they are narrowly tailored measures that further compelling governmental interests."6 This decision was handed down by the Court just three days before the initial short application form for the C block auction was due.69 The FCC decided to postpone the C block auction until the Commission received input from potential bidders and evaluated what impact the Adarand decision would have on the auction.
Following Adarand, the FCC decided three goals were to be pursued by the Commission. First, additional market competition needed to be introduced by the rapid delivery of wireless services of C block licensees. Second, the FCC wanted to reduce the risk of a future legal challenge to the auction under the new Adarand standard. Lastly, the Commission was concerned with keeping disruption of an applicant's plans to a minimum. Minimal disruption was important because many potential bidders were in the advanced stages of planning when Adarand was announced.70 The FCC opted to define its categories purely in financial terms. Rather than only allowing minority-owned businesses to receive equity financing, any small business that qualified could obtain equity financing up to 49.9 percent.7' This meant that so long as the applicant, or its control group, controlled 50.1 percent of the applicant's total equity, then the small business applicant could obtain outside financing for the rest of the capital needed to bid for a C block license.72Those applicants who could obtain an installment payment schedule were also specified in financial terms. The FCC created three different financial classifications for potential bidders. All bidders were required to first make a down payment of 10 percent of the company's winning bid.73 The first 5 percent was payable within five business days after the auction closed, and the second 5 percent was payable within five business days after the application was granted.74 If a winning bidder had gross revenues exceeding $75 million in each of the two preceding years, then the winner was to pay both principal and interest over the term of the license. The interest payment at this tier was the "ten-year U.S. Treasury obligations applicable on the date the license was granted, plus 3.5 percent."76 The second tier was for those companies or

firms whose gross revenues did not exceed $75 million for each of those two preceding years. The companies that qualified for this second-tier qualification were only responsible for the interest payments during the first year, and then payments included interest and principal amortized over the remaining nine years of the license.78 Interest rates were the same ten-year Treasury obligations, but the additional percentage added to that amount was only 2.5 percent.'9 While these terms were favorable, the most lucrative payment schedule was reserved for those bidders who qualified as small businesses.so A small business for purposes of C block bidding was defined as an entity that, together with any affiliates or ownership interests, had average annual gross revenues of not more than $40 million in any of the three preceding years.8' The installment payments for these small businesses were at the rate of the ten-year Treasury obligation on the date the license was granted. The first six years were to consist only of interest payments, and the last four years were to be amortized interest and principal payments.sz These changes in light of Adarand had consequences that impaired the ability to collect winning bids in the C block auction. C. Goals of the FCC The FCC was forced into a precarious position that caused certain failures in the C block auction. The first failure was an attempt to reconcile two different goals that were contradictory in nature. Congress explicitly wanted the FCC to ensure the diversification of spectrum ownership. To this end, the FCC was to "disseminat[e] licenses among a wide variety of applicants, including small businesses, rural telephone companies, and businesses owned by members of minority groups and women."83 The dissemination of licenses to minority groups and women through the C block auction was frustrated by the Supreme Court's ruling in Adarand, and the FCC decided to modify its auction rules. When the FCC changed its rules to draw distinctions using financial definitions exclusively, it also hoped that these changes would encompass Congress's concerns about minorities and women. The rule change was an attempt to define a nonsuspect group in financial terms, and the FCC hoped this group would significantly correlate with the woman and minority-owned businesses that Congress wanted to aid. The FCC commented on its changed rules by saying: "Although the revised rules do not specifically target minorities and women, we realize that because a large number of minority- or women-owned businesses are small businesses, our new rules will nonetheless, afford designated entities opportunities to participate in the C block auction."84 The FCC recognized that such tracing of groups is incomplete and that some minority and woman-owned businesses would not be able to use the most favorable installment plans available for the C block auction. While some companies would be burdened by the new rules, the Commission believed that other values outweighed those financial burdens. These other values were the need to reduce litigation risks, to increase market competition, and to promote rapid service to the public.86 It should be noted that these were the only goals related to the minority and woman-owned business portion of the congressional mandate. Additionally,

Congress stated that the goals of the FCC included promoting the efficient use of the spectrum, promoting economic opportunity, developing new technologies, and recovering the value of the spectrum for the public.87 While the FCC was to consider monetary recovery of the spectrum's value for the public, it was forbidden to use the expectation of auction revenue for the federal government as a "finding of public interest, convenience, and necessity."ss These competing goals are not only difficult to achieve by one federal agency, but both goals may be contradictory and therefore impossible to pursue all at once. For reasons explained later in this Note, the primary goals of the Commission should be efficiency and the establishment of property rights in spectrum. This means putting spectrum in the hands of those who value it most. While this may simultaneously raise revenue for the federal government, efficiency, not revenue maximization should be the first concern of the Commission. IV. WHAT WENT WRONG WITH THE AUCTION AND HOW IT IS BEING FIXED The main problem facing
the FCC was that many auction winners expressed concerns with meeting payments to the Commission. In fact, as noted before, three bidders in the C block auction have declared bankruptcy. This created further predicaments when considering how spectrum licenses should be treated in bankruptcy proceedings.89 Are such licenses property interests protected by the bankruptcy law, or do these licenses forfeit back to the FCC, which can then reauction them?9 These are just some of the consequences of the C block auction that should be addressed in any FCC attempt to fix the problem. A. What Went Wrong? The primary problem in the C block auction is two-fold. First, the initial A and B block auction involved participants who were, for the most part, seasoned veterans of the communications industry. This gave those participants a head start for building the infrastructure necessary for any PCS network. They also had substantially more cash and capital resources upon which to rely. This meant that winners of the first two auctions could compete more aggressively on a price basis. It also meant that they had experience in marketing, advertising, creating a service network, and infrastructure maintenance, which newcomers to the industry (C block licensees) did not have.

The second major problem is that the C block auction drove the values of spectrum licenses higher than their market value. This occurred because small businesses were not able to realize the true up-front costs. Since these types of companies had ten years to pay the cost of the auction at interest rates below market value, sometimes with the aid of bidding credits, it was difficult for a company to estimate what it could afford to bid. Therefore, there was a tendency to overbid. The idea for such lenient terms was that the company would be able to make payments over the tenyear period with profits derived from that license. This estimation of future profits was imperfect. When an economically rational company decided to bid on a C block auction, it first needed to determine what costs it would

incur over the life of the license. After that, there existed a need to estimate projected revenues from operations of the PCS license. Using the estimated profits over the next ten years and reducing that amount to its present value, the firm could have determined a rational bid. This rational bid would represent a close market approximation of the value of the license. The problem with this simple formula for valuation of licenses and appropriate bids was the information costs associated with such future projections. It should be remembered that the FCC was encouraging the introduction of small businesses into the PCS market. Since the requirement of a small business was that it have less than $40 million in gross revenue for each of the last three years, and considering the high cost of entry into the communications industry, it can be assumed that many of these small businesses had little experience in determining the valuation of licenses. Therefore, they were unable to determine optimal bids. Even if these small companies were controlled by persons with experience in the industry, PCS was and is a new technology where much is expected and little is certain. Information is highly imperfect in such a situation. It is safe to say that some bidders incorrectly determined the optimum bid.

What seemed to occur instead was a sort of "feeding frenzy." With highly unknown profits ahead, most companies thought of PCS as an unlimited gold mine. Evidence exists that C block participants ignored market-setting valuation comparisons.9' If a small firm with little experience is attempting to evaluate a license, it is rational to predict it would look at previous auctions of similar spectrum. In this case, those would be the A and B block auction. This especially seems the case given A and B block competition was greater with two potential licenses for each market and the participants had "deep corporate pockets."[92] The C block auction may have turned into a speculative frenzy because the bidders failed to observe the experience of larger wireless concerns in the A and B block auction.[93] This seems to be supported by the fact that the average price per POP in the C block auction was more than triple that in the A and B block auction. Gross speculation concerning the valuation of spectrum was not participated in by all bidders. Two significant bidders, U.S. Airwaves and PersonalConnect Communications, left the auction block when total bidding surpassed the $7 billion mark.4 While U.S. Airwaves planned to create a national presence in the auction by creating alliances with other winners, the company departed the auction because it believed bidding was at an unacceptable level and the markets to be created were not economically viable. This implies that even considering strong financial backing the licenses in the C block were overvalued.95 95 While some businesses in the C block may have had strong financial backing, general financing may have been another cause of the C block's problems. Most C block bidders failed to arrange adequate financing before the auction took place.9' This is just the opposite of what companies participating in the A and B block auction did. C block bidders believed they would obtain financing before the auction because that

financing was readily available to larger concerns like Sprint PCS.97 This was a mistake on the part of the small businesses involved because such previous financing was probably obtained through brand-name leverage. The small businesses involved in the C block auction had little experience, no brand name, and were forced to compete with larger concerns.98 It was error to believe that financing for the start-up of wireless service would easily occur after the auction was completed. B. What Was Done to Fix the Problem? On October 16, 1997, the FCC released an Order giving winners of licenses in the C block auction four options regarding their licenses and payments.99 The first of these options was to continue present payments for the licenses won.'oo Second, one could follow a disaggregation plan.'o' Under this plan, a C block licensee may have surrendered 50 percent of its spectrum to the FCC for reauction.'0 Third, a C block licensee may have given all of its licenses back to the FCC, and then all of its remaining C block license debt would be forgiven.t3 The last option involved paying up front the remaining costs without interest.'4 This allowed the licensee to use 70 percent of its down payment and any new money to pay off the C block licenses won.'5 Any licenses not prepaid would then be forfeited back to the FCC for reauction.'6 There were many other solutions suggested, including changing the amount owed for licenses, which the FCC rejected.'07 It is believed that such changes were not in the public's best interest. Among many policies advocated by the FCC supporting the four-option Order, one included reassuring the integrity of the auction process. Considering those that participated in the auction but did not win, the FCC sought to ensure fairness to all participants in the auction process. This included those who won licenses in other auctions like the A and B block.'9 Another concern of the FCC was not merely to postpone the situation, but to make a decision that resolved the issue in a rapid fashion. Two other policies supported by the FCC were creating certainty in the auction process and promoting economic diversity and competition in the spectrum market.1I Regarding the first option of continuing installment payments, all installment payments for C block PCS licenses were suspended on March 31, 1997, until further notice."' In order to avoid delay, those wishing to continue their installment payment plans were required to begin payment with the Suspension Orders rescission. This occurred on March 31, 1998."2 There was a sixty-day grace period after which licensees who did not submit payments or choose another option were in default.'3 Payments that were to have been made during the suspension period are payable over a two-year period, making one eighth of the suspension period amount due with each quarterly payment.'4 No extensions past the sixty-day grace period were permitted by the FCC."5 The second option, which allowed the surrender of half of a company's spectrum to the FCC for reauction, was designed to disallow winners from benefiting at the FCC's expense. The FCC allowed an entity owning C block spectrum to disaggregate to another C block eligible entity for the first five years following the license. "6 The entity buying the spectrum was and is allowed to make the same installment payments as

the original designated entity." After the five-year period, a company may disaggregate to any non-entrepreneur block licensee so long as the FCC is compensated for unjust enrichment regarding the amount of spectrum.l's When disaggregating half of the spectrum back to the FCC, the C block licensee must have disaggregated half of the spectrum (IS MHz) it has across all BTAs in a Major Trading Area (MTA).m9 The reason for this is simple. The company must disaggregate 50 percent across such a large area to avoid choosing which spectrum is advantageous for it to give back to the government. If a company were allowed to disaggregate whatever amount of spectrum it chose, it could selectively keep the spectrum in the best market or give back the spectrum if it believed the bid price exceeded the market value of the spectrum.*zo

While the FCC reduced the debt owed by half, the government retained the portion of the down payment applicable to the spectrum.'2' All previous installment payments were applied to reduce the amount of interest over the suspension period from March 31, 1997 to March 31, 1998, and were to be made over the first eight payments commencing on March 31, 1998.122 Finally, in order to avoid unjust enrichment, C block licensees electing this option were prohibited from bidding in the subsequent reauction of spectrum disaggregated from the licensee or reacquiring the disaggregated spectrum by a secondary market transaction for a two-year period.123 The amnesty option did not contain as many difficulties as the 50 percent disaggregation plan. Part of this is due to the fact that "cherry picking" of favorable pieces of spectrum was eliminated.24 The amnesty option allowed any C block licensee to surrender all licenses in spectrum for a relief from all payments on that spectrum. This included waiver of any default payments and return of prior installment payments made.' By allowing an amnesty option, the FCC attempted to speed use of C block spectrum to licensees who could afford to implement systems to use the spectrum. Consistent with the implementation goal set by Congress, a company that has built-out a system could keep the spectrum being used and qualify for amnesty for the remaining licenses.l26 If a company chose this option, the build-out must have occurred prior to the FCC Second Report and Order in question, and, to avoid cherry-picking, the company must keep all other BTAs within the MTA that has been built-out.l27

Because the FCC allows an entity opting for amnesty to bid in any reauction, there must be adequate measures against allowing unjust enrichment. The method chosen by the FCC was to retain the down payment from the original C block auction.'2 By retaining 10 percent of the bid payment (the amount of the initial down payment), an adequate penalty was created to discourage speculation.l29 At the same time, the licensee benefits by avoiding default payments and gaining a chance to stay in the spectrum market in the reauction. Since default in this option is avoided, the licensee's creditworthiness is not damaged for application to other

federal loan programs.

Under the prepayment option, a C block licensee must have prepaid for a license, and the remaining licenses not paid for must have been surrendered to the FCC.131The licensees who selected prepayment could have used 70 percent of their total down payments made on licenses that they chose to surrender.'32 The licensee may then use any additional "new money" to pay for its licenses under the prepayment option.133By only allowing licensees to use 70 percent of down payments from surrendered licenses as pre-payment for retained licenses, the FCC hoped that the 30 percent loss would act as a deterrent to excessive bidding in future auctions.'34 To have permitted a C block licensee to use 100 percent of the forfeited license down payment would be unfair to those who lost the auction and to those who continued to pay under the original payment structure.l35 A large amount of debate surrounded what amount should be prepaid for a license. There are three possible ways such amounts could have been changed. First, the C block auction bid price could have been reduced to prices paid for comparable A and B block licenses.136Second, the bid price could have remained unchanged, just prepaid.137Third, the price of the winning bid could have been reduced to its present value, and then prepayment would occur.138 The FCC opted for the second possibility and decided to keep the bid price the same under the prepayment option.139 The FCC maintains the reason for this choice was that it was the only method of calculation that was fair to other licensees. "In other words, licensees should pay what they bid."'4 Finally, to avoid selective "cherry picking" of licenses, the FCC limited which licenses could be surrendered.144Again, a C block entity must have prepaid all BTAs within an MTA. The licensee could not just selectively choose which licenses to forfeit while repaying others. An exception to this existed if the licensee did not have sufficient funds to prepay all BTA licenses within the MTA.l43 Any licensee must have prepaid for all licenses within an MTA that it could afford, if it had enough money to pay for more than one license, but not all licenses within the MTA. Also, if a firm surrendered a license, it was prohibited from reacquiring that license in a secondary market transaction for two years.TM

The FCC's four options for C block winners have been met with mixed results. According to PCS Week, the numbers are as follows: "120 licenses in bankruptcy, 144 returned, 119 disaggregated, 87 resuming payments (including 3 for which no election was made and 6 for which defective elections were made), 21 in the hands of the FCC, and 2 which have already been paid off by licensees."'45 The FCC reauctioned spectrum in its hands on March 23, 1999, the largest change being the elimination of installment financing.'46 The FCC retained the previous auction's eligibility parameters,l47 sped up the final payment,'48 and created bidding credits for qualified entities.'49 While these are steps in the right direction, they simply provide a patch for the problems faced by Congress and the FCC.

It is not this Note's contention that the FCC necessarily caused the problem in the execution of its auction. The rules of the auction were clear and objective. The problem was the policy underlying the rules of the auction, specifically those rules creating special payment plans for small entities. This, combined with the shortsightedness of the bidders, was the major problem of the C block auction. Given the fact that the FCC plans on granting bidding credits to qualified entities, it still ignores the basic conceptual problem. Economic reality dictates that winners be given a property right in spectrum and that auctions reward winners who value the spectrum most.

V. How SHOULD THE C BLOCK AUCTION BE REMEDIED WITHIN THE GIVEN FRAMEWORK?

As a scarce good, the spectrum's distribution will be efficient if two things occur. First, the spectrum should be distributed to those who value it most. Secondly, from a societal perspective, there should be sufficient competition in the market to ensure accurate prices. However, one thing that must be avoided in this process is a dramatic change in the rules. Companies can only make rational long and short-term decisions when they can count on regulatory law being predictable.'5 If the FCC was to change the rules of the auction or the corresponding payment plans in an ad hoc fashion, significantly deviating from the prior rules, companies involved in future auctions would be frustrated. The uncertainty of FCC changes would have to be projected into current bids, causing further means by which valuations could deviate from the actual market value.

All of this means that when the FCC attempted to correct the problems with the C block winners' ability to pay for their winning bids, the goals of competition and placing spectrum with its most valued user should have been balanced with the need to be consistent with prior rules. This is not to say that when the FCC designs future auctions it should not publicly change the policy and rules it will follow, but that when correcting prior mistakes the word of the issuing agency must be considered good to potential bidders. Within this framework, the FCC should have only either allowed those with winning C block bids to continue their present payment plans or to have prepaid for their licenses at the net present value. Also, companies should have been allowed to sell their spectrum to any entity that can afford to buy it so long as one of the two following options is utilized. When the first option is chosen (paying under the current installment plan), all concerns are taken into account. First, the rules of auction are satisfied. This in some way means a "deal is a deal." Fairness to losing bidders is upheld because the winner is not given favorable treatment. Also, the word of the FCC is not broken. Those participating in future auctions will be able to depend upon the FCC, allowing winners to follow the terms of the auction. This option is not completely efficient, but the partial loss of efficiency is compensated by the informational

efficiency (entities can count on the terms of the FCC) created in the future. When a firm keeps its obligations under the current installment payment plan, there is a good chance more competition will enter the market. If the spectrum was allowed to be sold, and the new owner paid under this option, competition would still be enhanced. This means that prices would tend more toward a competitive market because the number of firms is increasing. By allowing the original winner to sell to another party, those entities that could have secured better financing may have gained control of spectrum and would have brought it to the market quickly. This would create a more efficient market by increasing competition and would still closely following the original terms. Unfortunately, there would be some inefficiency because spectrum does not necessarily gravitate toward those who value it most. While those that won the C block bidding, or those willing to buy at that price, will retain the license, others who truly value it more may not have access to ownership. Part of this is due to the exclusion of nonentrepreneurial entities who may have wished to bid more at the original auction. While they may be able to buy the spectrum on the secondary market, there is an inefficiency because time has passed and the license may be less valuable. The buyer may not now be willing to purchase because the spectrum was only valuable before other networks were in place and operating. Another reason that spectrum may not tend to gravitate to those who value it most is the information problems with the auction. If firm A believes a license is worth $100 million and is willing to pay for it, and firm B believes a license is worth $300 million and is willing to pay for it, then the license will go to firm B. The problem exists when firm B inaccurately estimates the true price of the license and the amount it can afford to pay. For example, assume a particular license is worth $110 million, and because B, a small firm with little experience in the industry that needs money to build the infrastructure, really only has money enough to bid $95 million. The license will go to B but should have gone to the firm that left the auction at $100 million. This demonstrates the problem of normal demand versus effective demand. The license may often go to the firm that demands it more but does not have the resources to make the demand effective. This explains why the installment payment plan may not always efficiently distribute spectrum. Option two would have allowed an entity to pay for spectrum at its net present value or allowed someone to purchase the spectrum from the original winner and pay the FCC in this fashion. This option would have been more efficient than the original installment plan but deviates from the informational efficiency of not changing the rules. The FCC prepayment plan differs in that it does not discount the bid to its present value, but instead makes the company prepay the entire amount of the bid.151The Commission claims that in order to bring credibility and integrity to the rules the amount due under prepayment must be the net high bid.' So, under the FCC proposal, the C block winner would have to prepay the entire principal amount but not the interest due.

There was support for the net present value approach. Representatives Edward J. Markey and W.J. Tauzin asked the FCC in a letter to support a full price buyout where the amount paid would have been the net present value of the net bid prices for the C block spectrum in question.153 This support was well placed. The net present value approach would not have compromised the integrity of the auction rules. First, any licensee would have been allowed to continue with the present system of installment payments. This would satisfy literal compliance with the auction rules. Second, unlike a mortgage where the housing price and the financing arrangement are separate entities, the bids for C block spectrum were different. The companies involved in the auction were bidding on a single thing, paying for a license over ten years at low rates. This was the case because the auction was designed for those entities that could almost never afford to buy a license outside the installment payment system. The bid price not only represents the spectrum but also encompasses the right to not pay up front. By allowing up-front payment, the bid price must be reduced to the licensee's present value, in order to truly represent the present market value of the spectrum.

In connection with efficiency, the "prepayment of net present value" option had a couple of advantages. One advantage was that the FCC would no longer be in the position of a long-term creditor because payment would have occurred immediately. By making the FCC a creditor, an inefficiency resulted because the agency was not equipped to assume that role. One possible solution might have been to sell the creditor's rights of the FCC in the private market. The next large efficiency advantage of prepayment regards an aspect of timing costs. The more delay that exists before new systems of C block spectrum can be built-out, the more barriers to entry increase. This is due to the fact that other providers will have had the advantage of experience, an intact infrastructure, a price advantage, a market subscribed to its services, and brand recognition. Part of this market advantage would be the fact that existing service contracts may exist for some months into the future creating a high transaction cost to switch services within the contract period. This gives preexisting companies in the market time to react to any new market participant.

Prepayment decreases the time before spectrum goes to market because any company that elected this option must surrender any spectrum for which it could not prepay. Of course the relevant "cherry picking" provisions must be in place, so that in a subsequent reauction the spectrum will have some value to the market. Under the installment plan, it may be several years before an entity realizes it cannot fully pay and must default on some of its licenses. This delay may cause the spectrum to lose its value because of existing competition in the market.

There was also an informational efficiency that would have been created by using the net present value approach. A company would have had immediate access to the true cost of a license and could have compared it with existing market conditions. This would have applied to any entity that attempted to buy the spectrum from the existing C block holder. The buying entity would have been able to judge the market conditions at the time, whether it could make a profit, and whether the bid price is reasonable considering these factors and the economic outlook. The installment plan lacked this advantage because the bid price would have been analyzed over the longer period of ten years, and specific market conditions would become more unpredictable over time. It should be noted, however, that either option created an interest rate risk if the buying entity took out interest loans to prepay for the spectrum. It would consider which rate is more profitable-buying the spectrum up front with a loan or accepting the FCC terms for installment payments.

These two options, the current installment plan by the original terms of the C block auction and a prepayment plan at the bid's net present value within the given framework, should have been given full consideration. Together they would be the best solution obtainable while still remaining true to the original terms and goals of the auction. VI. WHAT EXACTLY IS EFFICIENCY, HOW DOES IT RELATE TO A VALUE-DRIVEN POLICY, AND WHAT WOULD
EFFICIENT SPECTRUM POLICY LOOK LIKE? To obtain a better idea of what efficient spectrum policy based on economic principles would look like, it is necessary to understand what efficiency is. Often, the concept of efficiency is compared to value-driven laws or regulations. While some may argue that the criminal law is efficient,'54 most see it as reflecting a different set of values not entirely based on economic concerns. On the other hand, principles in contracts and torts are sometimes solely based on economics. Rationally, it may seem that most law falls somewhere in the middle; that is, some law is based on economic notions of efficiency and property rights, while other areas of law emphasize different protections of an individual's rights. An in-depth discussion of this dichotomy in other areas of law is outside the discussion of this Note, but spectrum policy should be determined upon an efficiency framework, based on objective, economic principles.

A. What is efficiency and how does it relate to the concept of values?

Many consider economic efficiency and morals or values to be two different methodologies of justifying law, regulation, and policy. It is not uncommon to overhear a proponent of law and economics support a given decision because it is efficient, and then hear an opponent decry the policy because it ignores societal values. This type of categorization is a false dichotomy. Thus, the two categories can be reconciled. It really is the

case that efficiency is itself a value that can be chosen to justify a law or policy. Ultimately, the question is what underlying beliefs create a particular value.

Traditionally, efficiency comes from a value system that is utilitarian in nature. A utilitarian believes that societal or individual happiness, wealth, or prosperity should be maximized without regard to who bears the ultimate burden. Utilitarianism itself is a moral theory. It derives from the philosophical theory that morality is a form of hypothetical imperative. This means that if X is a rational goal, and Y will achieve that goal, then Y is the moral action.'55 This demonstrates how efficiency and utilitarianism are ultimately a value or moral judgment. If maximizing happiness or prosperity is a rational goal, as most say it is, then a policy that is efficient (creating the highest level of societal wealth or prosperity) is the moral choice.

Utilitarianism is only one moral system justified by the hypothetical imperative; a more rational argument can be made for a system that utilizes the hypothetical imperative but does not have as its primary goal the maximization of societal wealth and happiness (although these may be byproducts of that system). One of the best arguments for a moral system that favors economic freedom, private property, and the efficiency thus created, rests upon rational human nature. A person's only tool for survival is his mind. In order to survive, an individual must be productive, and this implies using his mind to produce the means of his survival. This requires that an individual be allowed to keep the products of his own labor; essentially government's role is to establish property rights for this end.'56 This results in distribution of goods and services to those who value them most and to those who will put them to their most productive use.

This can be compared to other noneconomic forms of value or moral judgments often used to justify other areas like criminal law. While this Note takes a contrary position, most believe that other moral goals (such as "thou shall not steal") are not part of a hypothetical imperative. Rather these morals take the form of a duty or rule. There is no justification for murder or stealing; it is wrong every time. One has a duty to obey the rule "thou shall not murder or steal."157 These goals are not the means to an end; they are the end. It is not that efficiency and economics are outside the realm of morals or values, but that different areas of law are often justified by others who use different methodologies.

Rejecting this dichotomy, all areas of law including economic and property law, contracts, torts, and criminal law have a common justification. The law defines when the government can utilize force. This protects individuals because it defines the very limited circumstances in which

force may be used in the social sphere. The main difference between areas of law is their focus, and it is not the justification of different areas of law with different methodologies. Economic areas of law seek to protect ongoing rights in property (usually this applies when no direct intentional use of force has occurred). Areas such as criminal law seek to remedy the violation of an individual's rights by an act of force (physical or nonphysical) that has been employed with some level of culpability.

Goods that are distributed by an efficiency standard are those that traditionally have been classified as economic goods and thus usually fall under property law. Moral goods are definable but lack characteristics common to economic goods. Economic goods are usually material in form because they are easier to measure and quantify for economic reasons. Therefore, peace of mind may be a good that someone is willing to pay for, but usually is not considered under economic analysis because it is so difficult to measure for any modeling purpose. That is one quality of a traditional economic good; it can be measured, and it is usually material. Other attributes are that the good be divisible and transferable. If the good cannot be divided and transferred, then it is difficult for any market to develop for the good. Another quality that is important is that ownership rights be clearly defined and supported. It is very difficult to claim one's own peace of mind, and then transfer it to another.

Since efficiency deals with values surrounding economic goods, it is necessary to focus on what is efficiency. Three areas of efficiency will be considered. The first is that the market correctly values the good in question. This can be called an informational or price valuation efficiency. Second, efficiency concerns the distribution of goods to those who value them most. Under economic theory, valuation is very simple. The person who values a good most is the one who is willing and able to pay the most for it.158Third, and often part of the first area, is that efficient markets for goods are those that are competitive. The reason this overlaps with the first definition is that some may argue that competitive markets are necessary to determine prices accurately.

All of this indicates that a series of steps needs to occur when evaluating a policy, law, or regulation. First, one must ask whether the good is traditionally an economic good. If it is not, then an objective, rational noneconomic value inquiry may proceed. When it is an economic good, economic analysis should be the proper standard. Assuming it is an economic good, the second question to ask is whether the policy is efficient regarding the market for the good and its distribution. This requires a three-part analysis. Does the policy result in the good's price being accurately determined? Next, are those who value the good most receiving it? Lastly, is the market for the good competitive? Spectrum policy needs to meet these criteria.

Efficiency analysis should drive spectrum policy because of the nature of spectrum itself. The qualities of spectrum define it traditionally within the realm of economic goods. While the science is more complicated, it shares many of the same attributes that land does. First, it is divisible. Second, the rights can be transferred. Actually, the spectrum rights alone can be transferred at a minimal price (although the structure needed to use such spectrum is quite expensive). Third, spectrum can be used for multiple purposes, and the nature of the spectrum bandwidth determines the use much like certain land is useful for agriculture or manufacturing. Finally, spectrum can be clearly demarcated, and ownership rights can be asserted. These qualities of spectrum make it similar to almost all economic goods.

B. What Would an Efficient Spectrum Policy Look Like?

Spectrum generally should be regarded more like property than it is currently. At present, applicants are receiving licenses to provide specific services to the public. This means that those rights are more like a land-use permit than fee simple ownership of the spectrum.l59 This type of distribution is inefficient because it does not allow several things. First, the spectrum is not necessarily put to its most efficient use. The FCC may have determined what type of service may be provided on a particular band of spectrum, but it is doubtful whether such a use would be as efficient as a profit-maximizing owner. If more profits could be made by using spectrum for PCS than another activity, then PCS will prosper. Spectrum should be put to its most valued use.

It is also the case that some entities that value the spectrum more may be denied its use because their plan of service is not the same as the FCC's plan. This is an inefficient outcome. While the FCC does attempt to assign spectrum to its most efficient use, private valuation will often differ from the FCC's notion of the public interest. The FCC should be relegated to the role of the traffic cop, only preventing owners from interfering with other spectrum users.

1. The Argument for Private Property

Many arguments have been introduced in favor of private property. John Locke argued that since a person has ownership over himself, whatever is removed from the state of nature and then mixed with his labor should be considered his private property.'61 David Hume gave a three-part justification for property rights: human beings seek to improve their lives; people are benevolent toward other people, but not unlimitedly benevolent; and nature has only provided limited provisions for the fulfillment of wants. Hume argues that these reasons make necessary a system of property rules and rights that allow people to follow their own

interests and cooperate with other people. 62

This Note contends that the best justification of property rights regarding economic goods (including spectrum) is given by economist George Reisman. Private property is important because it relates to three factors essential to economic production: the profit motive, freedom of competition in the market, and division of labor. The profit motive creates the incentive to expand and improve production. It also balances the proper relative size of industry.163Reisman notes:

The profit motive is what balances the demand and supply of each product and ensures the most rational and efficient distribution of each product over space and time-among all the markets that compete for it-and its delivery into the hands of those individuals who, within the limits of their wealth and income, need or desire it the most.

Private ownership is important in this context because it provides the superstructure of profit and loss incentives. It is private property that will be gained or lost by the producers of a good. 165 Not only is the incentive for profit and loss important, but private property also ensures that a producer's control over the means of production corresponds to whether the property is used profitably or unprofitably.'66 If an owner is using the means of production profitably, then he is able to save and reinvest those profits, thereby increasing his ownership of the means of production. The owner who is unprofitable will lack funds to maintain or replace the means of production under his control. 167

Also important to economic production is the principle of competition. "If the profit motive is the engine which drives the price system, competition and the freedom of competition are the built-in regulator which provide the essential context in which that engine operates."'6 The right to compete in the marketplace is itself part of the concept of property rights. Freedom of competition is the abilitowners to use the means of production in any industry in which they see fit.'69 Private property in the context of spectrum would allow the owners to truly see the profit and loss derived from ownership of the spectrum. It would also allow them to use the spectrum they own in any capacity they wish.

What makes the free market system productive is division of labor. The concept of division of labor is that production of goods tends to be performed by those who can do it best.170 The importance of the division of labor cannot be underestimated. The process establishes which individuals are best at an occupation, what products will be produced in a given market, and what technology will be employed in production.17 Division of labor is dependent upon the profit motive and economic competition. Competition determines noneconomic decisions of market organizations in a

division-of-labor society. "Economic competition is necessary because the most efficient form of organization of a division-of-labor society is not automatically known."'72 As technology, products, and markets change, competition is the most efficient means of incorporating and evaluating the inevitable changes that will occur in the future.

Reisman's analysis applies to all economic goods, including the spectrum. Competition and the profit motive are necessary for the productive use of scarce resources like spectrum. Private ownership of spectrum is necessary to this process. Everyone benefits from the division of labor in society-not just the capitalist, but the population as a whole. Necessary to this division of labor is economic competition and the profit motive. These principles in turn derive from private ownership of the means of production like spectrum.
R.H. Coase in his article, The Federal Communications Commission, also makes a persuasive argument why the most efficient spectrum policy is to define spectrum as property.173 While confusion did reign in early spectrum broadcast use before regulation occurred, the reason is that no property rights were created in the frequencies. In comparing frequency policy to private property, Coase states:

Land, labor, and capital are all scarce, but this, of itself, does not call for government regulation. It is true that some mechanism has to be employed to decide who, out of the many claimants, should be allowed to use the scarce resource. But the way this is usually done in the American economic system is to employ the price mechanism, and this allocates resources to users without the need for government regulation.

Users would be able to buy the right to use a frequency in the manner in which they see fit with the restriction that they do not interfere with other users. To draw from the property analogy, simply because there are two different uses for a piece of land does not mean that a government agency must assign the proper use of that land. The government only need create sufficient property rights in the land and allow the market to distribute the land to the person who values it most.175
The important thing about property rights is that efficiency is enhanced because there is a reduction in transaction costs. Distribution and rent seeking by parties, either lobbying the FCC outright for licenses in a competitive hearing or for favorable auction rules for their group, is a wasteful use of resources from the view of society as a whole. By creating a one-time auction of spectrum and corresponding property rights, price negotiations can occur that reduce the transaction costs in a change of spectrum distribution. To truly recognize the cost of spectrum, such negotiation and sale of spectrum should also apply to government agencies.'7 Under a Coasian analysis, the aim of the FCC should not strictly be to minimize interference, but through an initial distribution

of property rights, to maximize output.'77 Any kind of property right interferes with someone's opportunity to use a resource, but the goal should be that gains from interference offset the costs of that interference.' This analysis means that once the rights of users have been initially determined, the secondary market would best rearrange spectrum to the most valued user. The simplest way to accomplish this is through an auction to the highest bidder and most valued user.17 This in turn brings the analysis of what an auction should look like.

2. Efficient Auctions
For the most part the FCC auctions have been relatively successful in allocating spectrum to the user who values it most. There are two problems with FCC policy. First, the licenses are not treated as property to be distributed by the auction. Secondly, the FCC should not have strayed from the prepayment of licenses in the C block auction. The Simultaneous Ascending Auction (SAA) is very efficient as a means of distribution. Activity rules are put in place to keep bidders from holding back bids and for keeping the auction moving forward at a good pace.'8 The SAA also has advantages over traditional auction techniques such as a sequential auction of licenses or offering all licenses in a single round using sealed bids.181

The reasons for not using these traditional auctions are many. One reason is that there are close substitutes for most licenses, and licenses are complementary. Complementary licenses are important because it means that the individual license is more valuable depending upon whether the user holds licenses for the contiguous area. This means that it is more efficient for some bidders to win licenses within contiguous areas. The SAA form of auction is efficient in this regard because of the simultaneous and ascending features of the auction. The ascending character of bids allows a bidder to view how his competitors value licenses and for which aggregations those competitors are bidding.183The simultaneous feature allows a built-in flexibility for bidders to choose whatever aggregation they seek to win and to change their bid depending upon what others are bidding for that aggregation.'84 This allows a bidder to have better information on what bids it can match unlike a sealed bid auction where bidding is blind.'g5

The FCC is experimenting with combinatorial bidding, which should be implemented if found to increase the efficiency of auction allocation. In short, combinatorial bidding allows an entity to enter a package bid for a group of licenses.'86 The example used by the FCC is to suppose Bidder A places a $100,000 bid for licenses one, two, and four, and Bidder B places a $500,000 bid for licenses two, three, and five. A computer system will then calculate the revenue maximization of the bids and award the highest bids during that round to the respective

package.187This type of auction is advantageous when strong synergies exist among licenses and preferences by bidders. A corporation such as AT&T may only be able to implement its business plan if it can win a nationwide service area, while a small company may only need local service area licenses.187This is one improvement that could and should be made if feasible because it improves efficiency in the auction process. Since this is one area where the FCC has done quite well, it is necessary to consider whether congressional goals for the FCC are efficient.

3. Congressional Goals for the FCC

While the FCC does have some latitude in determining policy for the spectrum, change must occur at the legislative level. Goals that must be evaluated are auctions as a means to raise revenue, provision of incentives to both diversify spectrum and increase competition, and swift distribution of spectrum to create networks quickly. While Congress wanted the FCC to raise revenue for the government, it was not the fundamental goal of the auction process. As long as the spectrum is distributed to its highest user at an affordable cost, society will be better off applying the revenue to the national debt.

One means of increasing revenue is to give bidding credits to force bidders to increase bids to the price at which they value the license. This does not always occur because a winning bid must only beat the second highest bidder, and not necessarily approximate what the winner is willing to pay for it.89 The main problem with such bidding credits is that there has to be some reasonable approximation of the bidders' valuations. If this could be done, it would be better to just sell the license at the amount valued. Also, to be successful, such credits must have significant restraints on secondary market transactions. Licenses may also go to an entity that values the license less when a bidding credit is given to a small bidder in order to stimulate a large bidder, but the large bidder's valuation is incorrect. The smaller bidder could win the license, and the FCC would have to pay for part of it with the credit amount. Given all the informational problems with predicting valuations, bidding credits to increase revenue should be avoided.

Increasing revenue for the government should not itself be a significant goal. Revenue maximization is not itself efficient. The only thing it accomplishes is redistributing money from the buying entity to the government. Spectrum policy should and has focused upon bringing service to the market quickly and placing spectrum in the hands of those who value it most. Divergence from this goal is unnecessary.

The FCC has also been given the task of increasing diversity and competition in the market for spectrum. First, diversity should not be the primary goal of the FCC. The quest for diversity is what created many of

the problems in the C block auction. The primary problem is that under FCC rules, diverse companies were those entities that had little capital or experience in the spectrum market. If an entity values spectrum more, then it is efficient for that entity to receive it. It does not matter whether the owners are entrepreneurs, minorities, or women. When determining the allocation of an economic good, such considerations are irrelevant.
The focus upon competition on the other hand is a little more complex. While it may appear that sufficient competition exists now, it is always possible that in the future more companies need to be in the market to make it competitive. The burden, it would seem, is on the FCC to demonstrate why special terms of financing and special designated blocks of spectrum are needed. What has also not been established is the number of industry participants necessary for adequate competition in the market. These concerns should be addressed before installment payment programs and other measures are used in the future.

There are two main problems with the use of installment payments and special designations for small businesses. First is the assumption that capital markets are inefficient. While the capital market may not be completely efficient, it only needs to be more efficient than the FCC. Since the FCC did not even consider ability to pay, in fact the qualifications used were contrary to ability to pay, the private capital markets would be better at picking companies to equip with financing for an auction. The mistake was to value small and minority business in and of themselves. Instead, private markets would value those businesses (which may include smaller corporations) that had the financial ability to pay, or those businesses with better business plans and forecasts.
The second point is closely related. The FCC should never put itself in the position of creditor. This is especially the case when the companies singled out are smaller concerns. Private lending institutions and capital markets are much better at handling debt arrangement and collection. It will rarely be efficient to determine lending rates outside of the market without tailoring those rates to the individual company. The use of blanket terms of interest and installment payments is absurd because not all winners will be in the same situation. The main point here is that the FCC was not required to conduct itself according to the rigorous standards of a market actor, but in the name of diversity ignored many of the economic realities regarding small businesses. Competition is a worthy goal, and the FCC should encourage many to participate, but there should not be special designations for some entities without a rational reason. The default situation should be a more complete set of property rights for the spectrum.

The last congressional goal given to the FCC is to speed spectrum licenses to the public so that systems are built-out rapidly. This congressional goal is efficient and is another reason why the FCC should not focus on

small business and installment payments. The goal of rapid deployment is to bring services to the market quickly. One reason this is so important is to reduce barriers to entry. The longer some businesses have licenses, while other licenses are held up, the greater opportunity prior winners have to gain what may be a difficult, even insurmountable advantage. This is where ability to pay becomes important. Under the definition of a small business used by the FCC, the companies most likely to not have proper financing to build a system will win a license.

Also important for the quick deployment of services is the payment up front for spectrum instead of allowing installment payments. Often, upfront payments force either a prompt payment or prompt default and reauction of spectrum. The up-front payment makes a company obtain financing before the auction so that it can pay the bid price promptly after winning. By allowing installment payments, there is the uncertainty of a company defaulting on its license, and then the delay of reauctioning the license to a user who values it. Also, up-front payments help in the valuation of spectrum because a company must base more of its bid on present conditions. When offered installment payments, not only is the prediction of advanced future revenue required, but a firm must also predict the future capital market's ability to refund future payments to the FCC. Incentives for rapid deployment may in some circumstances be used, but these should not include installment payments.

VII. CONCLUSION

Spectrum allocation by means of an auction has worked well. There are only a few changes that would ensure a more efficient market. The first of these would be to give spectrum the same rights as property and for the FCC to act more like a traffic officer. By giving a property right in auctioned spectrum, there is more development of long-term infrastructure; additional uses and experimentation with spectrum technology are encouraged; and private negotiation of spectrum conflicts or disputes can occur once legal rights are established. These changes, while efficient, are not always advocated because of the fear of monopoly power, but there has been nothing to support these fears.

The C block auction demonstrates how some auctions can go wrong. There are a few things that Congress and the FCC should learn from this. Diversity and competition are not necessarily the same. What the market needs is good competition regardless of whether the company is small, minority, or woman-owned. It is a mistake to assume that monopoly power will occur because many large companies engaged in the bidding. Part of the rationale for encouraging small business ownership is local control and diversification. This ignores the many economies of scale that larger companies will enjoy.

While the FCC needs to fix the current problem, it also needs to remember that companies with imperfect information need to be able to rely on the auction rules. The best way to accomplish this is to allow current payments to resume under the installment plan, or to allow prepayment at the net present value of the bid. In general, installment payments should not be used in further auctions. The risks of uncertainty are high, and the FCC is not efficient as a creditor because it has no experience in the lending area. If lending is to occur, the FCC must be able to evaluate companies on an individual basis to determine the feasibility of payment plans. In general, the problems that existed within the C block auction were created because too many goals were given to the FCC, and efficiency was not primary. Although helping small, minority, and woman-owned businesses may be valuable from a moral standpoint, the efficiency of the market should be the primary concern. This means an emphasis on the true valuation of the market value of spectrum, distribution of spectrum to the most valued user, and the ability to create a sufficiently competitive market. It should be noted that spectrum is a scarce economic good just like land and other items treated as property. When one tends to view the spectrum as a public policy experiment, with all the rent seeking that can occur through the legislative and regulatory process, efficiency shifts to the periphery. Efficiency should be the primary goal of congressional and FCC spectrum policy.

Footnote:

1. LuDwiG VON MISEs, HuMAN ACTION: A TREATISE ON ECONOMICS 655 (3d rev.
ed., Henry Regnery Co. 1966).

2. 47 U.S.C. 309(j) (1994 & Supp. II 1996).

3. FCC Report to Congress on Spectrum Auctions, Report, 13 F.C.C.R. 9601, 9612 tbl.1 (1997) [hereinafter Spectrum Auction Report]. 4. Mindy Blodgett, It's Time to Pay Up, COMPUrERWORLD, June 3, 1996, at 32.

Footnote:

5. Jared Sandberg, The Squeeze: Too Many PCS Providers Are Chasing the Same Market, and the Result Isn't Pretty, WALL ST. J., Sept. 11, 1997, at R22.
6. Curt Harler, Heads on the Block, COMM. INT'L, Aug. 1, 1997, at 20. 7. Id.

8. Riva Atlas, Trouble on the C Block: In Its Attempt to Help Out Entrepreneurs, the Government Created a Mess with Wireless Auctions, INSTITUTIONAL INVESTOR, Aug. 1, 1997, at 41.

Footnote:

9. Sandberg, supra note 5

Footnote:

12. Id

13. Id

Footnote:

15. Bryan Gruley & Quentin Hardy, Wireless Bidders in U.S. Threaten Default on Debt, ASIAN WALL ST. J., June 27-28, 1997, at 16.

16. Alex Philippidis, NextWave Files Chapter 11 in Wake of Mounting Debt, WESTCHESTER COUNTY Bus. J. (N.Y.), June 22, 1998, at 1. 17. FCC Sets C-Block Reauction for Next March, Whether Bankruptcies Are Resolved or Not, PCS WEEK, Aug. 26, 1998 [hereinafter FCC Sets C-Block Reauction]. 18. The enforcement role of the FCC should be limited to that of the government in most property disputes. This would mean enforcing any use infractions by third parties.

Footnote:

19. See generally Jonathan Blake, FCC Licensing: From Comparative Hearings to Auctions, 47 FED. CoMM. L.J. 179 (1994). 20. Spectrum Auctions Report, supra note 3, at 9608. 21. Id.

22. Id. This method of distribution of spectrum is codified at 47 U.S.C. 309(a)-(h) (1994 dc Supp. II 1996).

Footnote:

23. FCC Sets C-block reauction, supra note 17

Footnote:

29. 47 U.S.C. 309(i) (1994).

30. Spectrum Auctions Report, supra note 3, at 9609. 31. Christine E. Enemark, Adarand Constructors, Inc. v. Pena: Forcing the Federal Communications Commission into a New Constitutional Regime, 30 COLUM. J.L. & SoC. PROBS. 215, 219 (1997).
32. Spectrum Auctions Report, supra note 3, at 9609.

Footnote:

32. Spectrum Auctions Report, supra note 3

Footnote:

38. Id.

39. Id. at 9611. 40. Id. at 9603. 41. Id.

42. Id. at 9611.

Footnote:

43) Id at 9616

Footnote:

50. Id
Footnote:

57. In this context, the term "normative values" defines those values that some (including the majority of Americans) may think are socially advantageous but are not rational from an economic perspective. The desire to place spectrum in the hands of minority and woman-owned businesses falls into this category. While the FCC, Congress, and the American public may desire these outcomes, they are not economic values. Economic values are primarily concerned with allowing individuals to maximize their own production of goods and services. This Note argues that any company should be allowed to bid for spectrum, and that the company paying the most for it can put it to its best productive use.

Footnote:

58. 47 U.S.C. 3090)(3)(B) (1994).

59. H.R. REP. No. 103-111, at 254-55 (1993), reprinted in 1993 U.S.C.C.A.N. 378, 581-82.

Footnote:
60. 47 C.F.R. 24.709(a)(1) (1998).

61. Implementation of Section 309(j) of the Communications Act-Competitive Bidding, Fifth Report and Order, 9 F.C.C.R. 5532, para. 130, 75 Rad. Reg. 2d (P dc F) 859 (1994).

Footnote:

62. Id. paras. 133-34. 63. Id. para. 133. 64. Id. para. 137. 65. Id.

66. Id. paras. 139-40.

Footnote:

67. Adarand, 515 U.S. 200 (1995). 68. Id. at 227.

69. Implementation of Section 309(j) of the Communications Act-Competitive Bidding Amendment of the Comm'n's Cellular PCS Cross-Ownership Rule, Sixth Report and Order, 11 F.C.C.R. 136, para. 4, 78 Rad. Reg. 2d (P & F) 934 (1995) [hereinafter Competitive Bidding Sixth Report and Order].

Footnote:
70. Id. para. 1.

71. 47 C.F.R. 24.709(b)(4)(i) (1998). 72. Id 24.709(b)(6)(i).

Footnote:

73. Id. 24.711(a)(2).

74. 47 C.F.R. 24.711(a)(2) (1997) (superseded 1998). Current FCC regulations have changed the amounts and timing of payments attributed to the winning bidder's down payment and balance of payments. 75. 47 C.F.R. 24.711(b)(1) (1998).

Footnote:

76. Id.

77. Id. 24.711(b)(2). 78. Id. 79. Id.

80. Id. 24.711(b)(3). 81. Id 24.720(b)(1).

Footnote:
82. 47 C.F.R. 24.711(b)(3) (1997) (superseded 1998). Current FCC regulations have changed, the result being that the current rate of interest is the ten-year U.S. Treasury obligation rate plus 2.5%. Payments of interest only are for a period of two years, with the payments of interest and principal amortized over eight years.

Footnote:

83. 47 USC sec (j)(3) (B) (1994)

Footnote:

88. Id. 309(j)(7)CA)-(B).

89. In the case of General Wireless Inc., bankruptcy protection has produced favorable results. Judge Steven A. Felsenthal ruled that no exchange of reasonably equivalent value occurred, and this fell under the bankruptcy code's definition of "fraudulent conveyance." See Bankruptcy Judge Lowers Value of GWI's Licenses; Outstanding Debt Reduced to $60 Million, PCS WEEK, Apr. 29, 1998 [hereinafter Bankruptcy Judge Lowers Value]. Judge Felsenthal determined the appropriate value of C block licenses by comparing them to F block PCS counterparts. This means that approximately $894 million of debt will be avoided. Id. As of October 9, 1998, the U.S. District Court and the Fifth U.S. Circuit Court of Appeals have turned down the FCC's request to have the ruling stayed. See C-Block Licensee Rises from Chapter 11 Ashes, WIRELESs TODAY, Oct. 9, 1998.

Footnote:

90. At this time, the FCC will not include C block licenses involved in bankruptcy proceedings to be reauctioned. This will create the need for further auctions as these licenses are reclaimed. Amendment of the Comm'n's Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees, Fourth Report and Order, 13 F.C.C.R. 15,743, para. IS, 13 Comm. Reg. (P & F) 220 (1998) [hereinafter Installment Payment Fourth Report and Order].

Footnote:

91. Bankruptcy Judge Lowers Value, supra note 89 (discussing a bankruptcy court's decision that licenses were overvalued).

92. Marc Cabi, Finding a Resolution for the FCC's C-Block PCS Auction Debacle, RCR RADIO COMM. REP., Set. 15,1997, at 24.
Footnote:

93. Id.

94. Jason Meyers, Two C Block High Rollers Fold, TELEPHONY, Feb. 26, 1996, at 10.

Footnote:

93. Id

Footnote:

99. Amendment of the Comm'n's Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees, Second Report and Order and Further Notice of Proposed Rule Making, 12 F.C.C.R. 16,436, 9 Comm. Reg. (P & F) 1100 (1997) [hereinafter Installment Payment Second Report and Order].

Footnote:

100. Id. para. 6. 101. Id 102. Id. 103. Id. 104. Id. 105. Id. 106. Id. 107. Id. para. 5. 108. Id. para. 2. 109. Id.

110. Id. paras. 2, 4.

Footnote:

111. Id. para. 23. 112. Id. para. 25. 113. Id.

114. Id. para. 27. 115. Id. para. 30. 116. Id. para. 32. 117. Id.

Footnote:

118. Id; 47 CFR sec 24.714 (c) (1) (1998)

Footnote:

122. Id.

123. Id. para. 42. 124. Id. para. 56. 125. Id. paras. 53, 58. 126. Id. para. 57. 127. Id.

128. Id. para. 55. 129. Id. 130. Id.
Footnote:

131. Id Para.64

Footnote:

144. Id. para. 69.

145. C-Block Restructuring: Official Election Decisions, PCS WEEK, June 24, 1998. 146. FCC Sets C-Block Reauction, supra note 17. 147. Installment Payment Fourth Report and Order, supra note 90, para. 13.

Footnote:

148. Id. para. 35. 149. Id. paras. 45-46.

150. Relating to the issue of predictability, many C block winners are skeptical of staying in the PCS market because the FCC has made the situation too unstable. The CEO of Quantum Communications Group, Inc. noted his disgust with the FCC because the rules

Footnote:
would change whenever he developed a spectrum strategy. "'I finally got so frustrated because I couldn't make any sound decisions."' Few C-Block Licensees Willing to Stay the Course with the FCC, CoMM. TODAY, June 15, 1998.

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151. Instalment Payment second report and order, supra note 99, para, 66

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154. See generally Richard A . Posner, Economic Analysis of Law 237-70 (5th ed. 1998).

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155. While not believing in its correctness, Immanuel Kant gives an accurate definition of the hypothetical imperative. "The former [hypothetical imperatives] present the practical necessity of a possible action as a means to achieving something else which one desires (or which one may possibly desire) .... The hypothetical imperative, therefore, says only that the action is good to some purpose, possible or actual." KANT SELECTIONS 263 (Lewis White Beck ed., 1988) (quoting from Kant's book Foundations of the Metaphysics of Morals). An excellent example of the hypothetical imperative applied to ethics can be found in the works of Aristotle. See generally 2 THE COMPLETE WORKS OF ARISTOTLE 1729-42 (Jonathan Barnes ed., 1984). In the Nicomachean Ethics, Aristotle correctly argues that all actions aim at some end. The point therefore of ethics is to choose moral ends that reflect excellence. The most excellent of these ends that may be achieved is happiness. "[H]appiness is an activity of soul in accordance with complete excellence ...." Id. at 1741. This goal (happiness) is sought for its own sake, and moral actions are those acts that will achieve happiness.

Footnote:

156. This argument was primarily advanced by the philosopher and novelist
Ayn Rand. She argued that the economics of property rights is based
primarily on the fact that "man has to work and produce in order to support
his life. He has to support his life by his own effort and by the guidance
of his own mind." AYN RAND, CAPITALISM: THE UNKNOWN IDEAL 18 (1967).
To
fully support his life, Rand argues, he must be able to dispose of the
fruits of his labor. Id.

Footnote:

157. This value theory represents the philosophy of Immanuel Kant who
called this reasoning the categorical imperative. The categorical
imperative is derived by the following proposition: "There is, therefore,
only one categorical imperative. It is: Act only according to that maxim by
which you can at the same time will that it should become a universal law."
KANT SELECTIONS, supra note 155, at 268. This means that moral principles
are derived by establishing their universal applicability. Unlike the
hypothetical imperative, categorically derived moral principles do not seek
an end.

Footnote:

158. Willingness to pay for such a good is only partly correct. One must
also be able to effectualize this demand. The concept of effective demand
goes back even to the time of Adam Smith, and in essence means that one can
sufficiently afford to pay for what one demands. See ADAM SMITH, AN INQUIRY
INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 56 (Modern
Library ed.,
Random House 1965) (1776). This concept arises in Smith's analysis of
natural and market prices in Book I, Chapter VII. A person may demand a
Rolls Royce, but cannot afford it. That person would lack effective demand
for that automobile. So efficiency requires that the good go to the person
who values it most, meaning to the person who is willing and able to pay
for the good.

Footnote:

159. Kurt A. Wimmer & Lee J. Tiedrich, Competitive Bidding and Personal
Communications Services: A New Paradigm for FCC Licensing, 3 COMMLAW
CONSPECTUS 17, 19 (1994).

Footnote:

160. See R.H. Coase, The Federal Communications Commission, 2 J.L. & ECON.

1, 13 (1959).

Footnote:

161. JOHN LOCKE, Two TREATISES OF GOvERNMENT 128 (Mark Goldie ed., Guernsey
Press Co. 1996) (1690).

162. DAviD HUME, A TREATISE OF HUMAN NATURE 536-53 (Ernest Mossner ed., Penguin Books 1985) (1739).

163. GEORGE REISMAN, CAPITALISM: A TREATISE ON ECONOMICS 138 (1996).

Footnote:

163. George Reisman Capitalism

Footnote:

168. Id. 169. Id.

170. Id. at 144. 171. Id. 172. Id.

Footnote:

173. Coase, supra note 160. While Coase was only writing about broadcast spectrum, his arguments equally apply to more advanced users of spectrum.
Footnote:

174. Id at 14

Footnote:

180. R. Preston McAfee & John McMillan, Analyzing the Airwaves Auction, 10 J. ECoN. PERSP. 159, 160 (1996).

Footnote:

182. Id

183. Id

Footnote:

187. Id. 188. Id.

189. See generally Ian Ayres & Peter Cramton, Deficit Reduction Through Diversity: How Affirmative Action at the FCC Increased Auction Competition, 48 STAN. L. REV. 761 (1996).
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...TEXT: because it means that the individual license is more valuable depending upon whether the user holds licenses for the contiguous area. This means that it is more efficient for some bidders...

...bidder to have better information on what bids it can match unlike a sealed bid auction where bidding is blind.'g5

The FCC is experimenting with combinatorial bidding, which should be implemented if found to increase the efficiency of auction allocation. In short, combinatorial bidding allows an entity to enter a package bid for a group of licenses.'86...

2/7,K/3 (Item 1 from file: 20)
DIALOG(R)File 20:Dialog Global Reporter

23765893 (THIS IS THE FULLTEXT)
Net Exchange Advanced Combined Value Trading Framework Selected for Schneider Logistics' SUMIT CVA Procurement System
BUSINESS WIRE
July 08, 2002

SAN DIEGO--(BUSINESS WIRE)--July 8, 2002--Net Exchange, the leading transaction optimization solution provider, today announced the deployment of its combined value trading framework as part of Schneider Logistics' SUMIT CVA(TM) collaborative transportation procurement system. SUMIT CVA is aimed at providing shippers with a strategic approach to securing low-cost, long-term freight contracts. Schneider Logistics selected Net Exchange based on its proven and pioneering work in the architecture of combined

value markets. Net Exchange's combined value trading framework enables a multi-round auction in which carriers dynamically revise price and service lane combinations based on a shipper's requirements. Logistics consultancy Jos. Swanson and Co. collaborated with Net Exchange by providing important domain expertise in the deployment of Net Exchange's combined value trading framework into SUMIT CVA. SUMIT CVA is the first commercially available transportation procurement product based on combined value principles and is backed by Schneider Logistics' expertise at purchasing and managing more than $2.5 billion in freight annually. Operational since the fall of 2001, SUMIT CVA has delivered transportation cost savings of between five and 50 percent per bid and more than $200 million in long-term contracts have already been awarded using this new process. "Our customers' strategic procurement requirements are better served through the application of combined value principles and we were impressed with Net Exchange's ability to adapt its tool to the highly complex transportation procurement environment," said George Grossardt, vice president of Alliance Services for Schneider Logistics. "We were able to easily integrate Net Exchange's advanced combined value trading framework and customize its use to deliver this new procurement option to the freight industry." In a multi-round auction format, SUMIT CVA allows the efficient matching of carrier capacity with shipper demands by allowing carriers to bid on bundles of lane combinations and groupings of loads that reflect the best use of their transportation network. Compared to a traditional lane-by-lane procurement process, SUMIT CVA helps reduce risk and increase carrier asset utilization which translates to better rates for shippers. This breakthrough approach is enabled by Net Exchange's combined value trading framework that encapsulates process design and advanced technologies to determine the highest combination of value among bids. "Better transactions occur when the shipper and carriers find the match that most efficiently allocates shipments to each carrier's network," said Charles Polk, president of Net Exchange. "Schneider Logistics recognized that determining the optimal match among many possible fits is a capability not offered in the freight industry. Net Exchange's approach to transaction optimization finds these optimal matches, providing a distinct advantage to SUMIT CVA." About Schneider Logistics Inc. Schneider Logistics is a global lead logistics provider that helps customers extract strategic business value from their supply chains in the form of lower distribution costs, reduced inventory, improved customer service, and increased working capital. The company provides Fortune 1000 companies with a range of supply chain solutions including supply chain engineering, supply chain management technologies and outsourced logistics services. Schneider Logistics is a wholly owned subsidiary of Schneider National Inc., North America's leading provider of premium transportation services. About Jos. Swanson & Co. Jos. Swanson & Co. (JS&Co), provides logistics engineering services and strategic management counsel. JS&Co's clients range from railroad and trucking firms, to shippers, to equipment manufacturers and suppliers of warehousing

services, and designers of information systems. JS&Co have been active in the logistics sector for the past 25 years, providing their clients with imaginative and effective solutions to increasingly complex problems. Through their special focus on efficient auction technologies, JS&Co also serve participants in the emerging electronic business and telecommunications sectors. For more information about Jos. Swanson & Co., visit www.jsco.com , or call 262/638-9980. About Net Exchange Net Exchange is the experienced provider of solutions that optimize the value, immediacy, and adaptability of transactions that comprise commerce. In May 1994, faculty from the California Institute of Technology formed Net Exchange to commercialize solutions based on advanced research in computational combinatorial trading. These solutions marry planning optimization techniques with commerce execution and help firms to increase the value of business with their trading partners. To date, Net Exchange has developed combined value trading solutions for logistics, financial, and derivatives trading. For more information about Net Exchange, visit www.nex.com , or call 858/724-0390.

--30--ts/sd* CONTACT: Net Exchange Belinda Dittmar, 917/373-9173 bdittmar@nex.com TX

... that comprise commerce. In May 1994, faculty from the California Institute of Technology formed Net Exchange to commercialize solutions based on advanced research in computational combinatorial trading. These solutions marry planning optimization techniques with commerce execution and help firms to increase...

2/7,K/4 (Item 1 from file: 2)
DIALOG(R)File 2:INSPEC

10300167
Title: Simulating combinatorial auctions with dominance requirement and loll bids through automated agents
Author(s): Avenali, A.; Bassanini, A.
Author Affiliation: Dipt. di Informatica e Sistemistica, Univ. degli Studi di Roma "La Sapienza", Italy
Journal: Decision Support Systems vol.43, no.1 p.211-28
Publisher: Elsevier,
Publication Date: Feb. 2007 Country of Publication: Netherlands
CODEN: DSSYDK ISSN: 0167-9236
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Material Identity Number: F773-2007-001

DOI: 10.1016/j.dss.2006.09.008
Document Number: S0167-9236(06)00133-3
Language: English Document Type: Journal Paper (JP)
Treatment: Practical (P); Theoretical (T)
Abstract: When complementarity or substitutability relations exist among the items for auction, the use of combinatorial bidding (i.e. permitting players to bid on bundles of items) enhances the seller's revenue and ex-post market efficiency. We present a new first-price multi-round combinatorial format, where bids are subject to a stronger requirement than validity, and a new tool is applied, which in a sense generalizes the concept of waiver. The auction format is simulated through automated agents, assuming a model of bidders' beliefs about their opponents. We perform statistical analyses on simulation results, obtaining useful hints for the design of ascending combinatorial formats. [All rights reserved Elsevier]. (37 Refs)
Subfile: C D

Abstract: When complementarity or substitutability relations exist among the items for auction, the use of combinatorial bidding (i.e. permitting players to bid on bundles of items) enhances the seller's revenue and ex-post market efficiency. We present a new first-price multi-round combinatorial format, where bids are subject to a stronger requirement than validity, and a new...

... on simulation results, obtaining useful hints for the design of ascending combinatorial formats. [All rights reserved Elsevier].

2/7,K/5 (Item 2 from file: 2)
DIALOG(R)File 2:INSPEC

09336659 INSPEC Abstract Number: C2005-05-7120-017
Title: Oblivious comparator and its application to secure auction protocol
Author(s): Kikuchi, H.
Author Affiliation: Dept. of Inf. Media Technol., Tokai Univ., Japan
Journal: Transactions of the Information Processing Society of Japan vol.45, no.8 p.1898-907
Publisher: Inf. Process. Soc. Japan,
Publication Date: Aug. 2004 Country of Publication: Japan
CODEN: JSGRD5 ISSN: 0387-5806
SICI: 0387-5806(200408)45:8L.1898:OCAS;1-O
Material Identity Number: T205-2004-011
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Treatment: Applications (A); Practical (P)

Abstract: This paper presents a protocol for secure function evaluation (SFE) in which n players have secret inputs E[a/sub 1/], E[a/sub 2/], ..., E[a/sub n/], of a known Boolean function f, and they collaborate to compute the ciphertext of the output of the Boolean function, E[f(a/sub 1/, ..., a/sub n/)]. The main result is a completeness theorem (Theorem 3.1) which states that an arbitrary function can be evaluated at the oblivious party without help of private information. The proposed protocol is based on the Jakobsson and Juels's mix-and-match scheme (Jakobsson and Jules, 2000) in which the truth table of a target function is row-wise randomized (mixing) using a mix network, and then players perform "matching" the designated output ciphertext and the corresponding rows. The biggest difference between the proposed SFE and the mix-and-match is that the proposed protocol does not require any involvement of key holders to evaluate function, while the mix-and-match needs key holders to perform threshold decryptions at every step of evaluation of Boolean gates. One disadvantage of the proposed scheme is the Reed-Muller expansion (Sasao, 1997) involves an exponential blow-up in the number of input, n, as the same as the conventional schemes, e.g., CyptoComputer proposed by Sander, Young, and Yung (1999). This paper presents an efficient construction for a primitive called `oblivious comparator' with n-round complexity between the comparator and n players but the bandwidth spent by one communication is independent from n (linear to the size of values to be compared), and hence it does not suffer the blow-up in n. The oblivious comparator is suitable to implement a secure auction because an auctioneer communicates with bidders once at time, and performs evaluation without help of trusted key holders. In addition, the proposed construction allows arbitrary complicated functions including a search for second highest, a resolution the winner, and a dynamic programming (for combinatorial auction). (32 Refs)

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